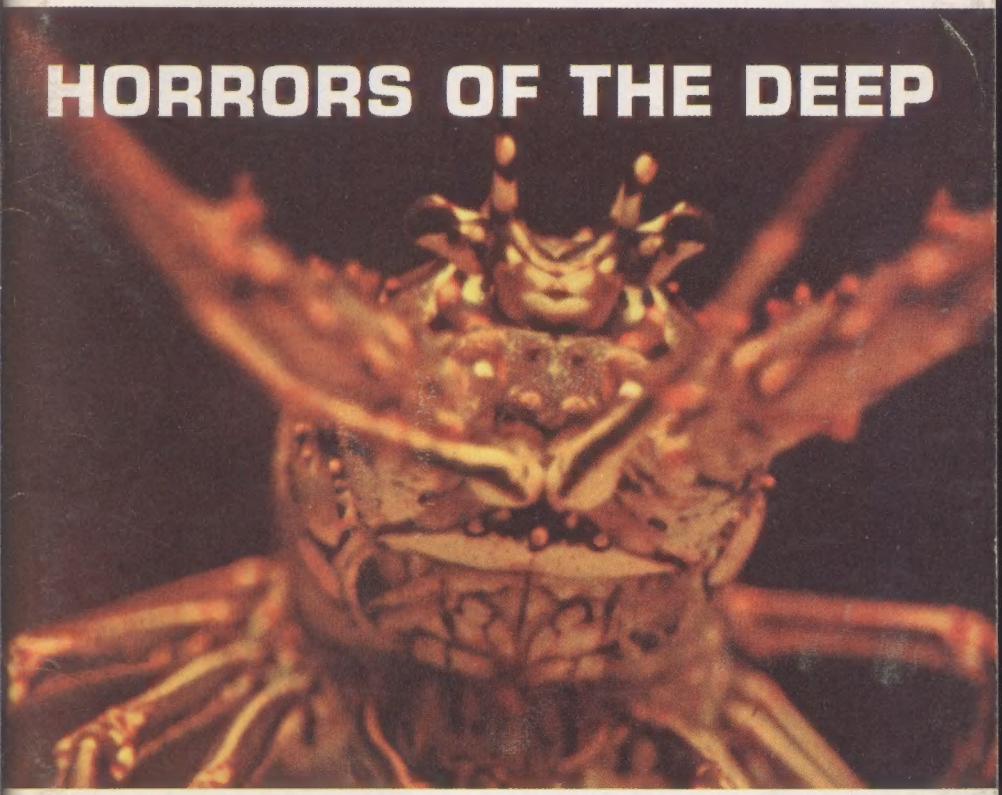
SEPTEMBER 1964 35 CENTS ICD

SCIENCE DIGEST

WHY AFRICAN BABIES ARE MORE INTELLIGENT



How we can change our emotions

THE AMAZING NEW OBJECTS IN THE SKY

Space probe that will float back

THE odd-looking space probe being assembled and pressure tested in a portable clean room (above) will serve as a sort of target for meteorites.

It is called an inflatable meteoroid penetration probe and it is being built by the Space-General Corporation, El Monte, Calif., under contract to the National Aeronautics and Space Administration. The probe will be lofted outside the earth's atmosphere by an Aerobee research rocket to detect the impacts of meteoroids.

As shown, the probe is upside down, with the instrumentation package at the top of the center boom. Sensors are distributed throughout the wing membrane.

When ready for launching, the probe will be packed in a small canister and deployed after the rocket is coasting through the atmosphere.

It will then extend out to 14 feet in the form of a bat-winged paraglider which will expose the sensors to meteorites.

The paraglider then will float gently back to earth so the equipment can be recovered.

SCIENCE DIGEST

Twenty-eighth year of publication

Photo: Bruce H. Frisch

This spiny lobster looks as horrible as any monster out of science fiction. Under the sea, many creatures develop remarkably bizarre shapes. A gallery of some of the strangest starts on page 6.

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ARTICLES

FEATURES

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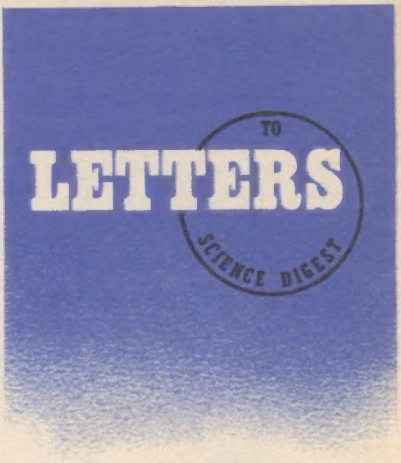


Dreams

In regard to the article "Was Freud Wrong About Dreams?" (July '64), I believe some erroneous assumptions are being made. References are made to "day remnants" as though Freud overlooked this phenomenon—he did not. He simply put a different wrapping on the same package and called it the "day's residue."

It is well known that all dreams do not lend themselves to interpretation. Also, might not an emotionally or mentally disturbed person have dreams that are indigenous to his own particular personality?

Again, might not the outside stimuli as offered by clinical experiment have some effect upon the dreamer? You actually answer in your own article by reference to the day's remnants, or as Freud called it, the day's residue.

I would also have to go on the assumption that the volunteers for this type of an experiment would have a given personality type. I

would even go so far as to say that all of the people that volunteered for this type of experiment are extroverts—an introvert wouldn't get that involved.

REX HALL
Boone, Iowa

Question of faith

In regard to your article "How Religion Helps to Heal" (July '64), I believe that there are a few things that have been left out.

First: Religious beliefs and standards of worship were set down for mankind long before the first appearance of medicinal drugs and even longer before psychiatry.

Second: I do not think it is right in the eyes of most people to try to find out the why and how of faith.

Third: I think we should be thankful for the very existence of religion and faith even if what Sigmund Freud said was true, that it is a neurosis, a figment of the imagination.

Religious faith has kept our whole country together in peace for the last 188 years since the Revolution. This country has had strong convictions to hold on to. But if we lose these standards of ours we will surely fall.

DAVID PETERSON
Brainerd, Minn.

Where is the gain?

The article "Alcoholism Controversy" (May '64) makes it seems as if the former alcoholic is a social degenerate if he isn't able to have a few friendly drinks. Does being able to drink mean that much to the public?

Take the quote, "There is no way

of telling how many former alcoholics can become normal drinkers, so experts are afraid to let them drink again." Should a man attempt to become a so-called social drinker, risking his future, his family, and all the time and pain it took to break from this evil habit? Is it worth the chance? If so—where lies the gain?

DONALD R. BAL
New York, N.Y.

First and last

I enjoyed your review of Bernard Smith's book *The 40-knot Sailboat* (May '64), but I must take exception to your closing statement. You urge readers to "start with the final chapter on basic sailing principles" because, you say, "in his book [Smith] has put first things last."

This gives the impression that the book is not well written. On the contrary, it is extremely well done and is wholly fascinating. If your reviewer had read Smith's foreward he would realize that the author "assumed from the start that the reader has at least a brushing familiarity with sailing practice. A reader without a background in sailing will find it profitable to browse through the Appendix [your reviewer's 'last chapter'] before reading the book. The author, therefore, seems to have beat your reviewer to the punch.

DONALD T. SANDERS
New York, N.Y.

"Well, you don't look like area code 609-924-6788!"

The causes of death

In the article "What Happens When You Die" (May '64) is the statement, "On the average, out of every 100 deaths in the U.S. today, 43 people die of heart disease, 17 people die of cancer, 12 people of cerebral hemorrhage, 6 people in accidents, 3 people die of flu and pneumonia, 3 people die of arteriosclerosis, 1 person dies of suicide." The total adds up to 85 people. What happened to the other 15?

JOHN C. FOTR
Rufus King High School
Milwaukee, Wis.

The missing 15 die from a variety of miscellaneous causes including diseases of the kidney, liver, etc.—ED.

A "crackpot" idea?

Twenty-five years ago, when I was a teen-age secretary, an elderly gentleman walked into my office and asked if I could type a rather lengthy letter for him. I hestitated because it was to the President of the United States. But since the man was paying

me to type, and the letter was not harmful—just a crazy idea from a "crackpot"—I went ahead and typed it.

Your article "The Biggest Building Job of All Time" (July '64) made me remember that letter. The man's idea was a waterway to replace the Panama Canal by making the Rio Grande navigable, and by adding other Western waterways, to connect it to the Pacific Ocean.

Some of the man's reasons were that such a project would give millions of Americans jobs and that it would provide a waterway within the United States.

Perhaps I am now considered a "crackpot" for passing this absurd idea on, but with man's ingenuity, is it absolutely impossible?

Mrs. H. E. Criss
Texas City, Texas

Beatles are fun

Having read the article "Science Looks at Beatlemania," (May '64) I feel as though there are a few adults who understand the American teenagers. I may be considered a bit stupid, but I have found rock and roll a complete drag. I have also found Beatle music fun and very greatly needed. In short, the Beatles are the greatest and three cheers for a good article.

Sharol Lee Butcher
Wapakoneta, Ohio

A happy meeting

I recently had to give a report in my biology class based on information from a science magazine. I went to our school library, where to my delight I "met" *Science Digest*. It interested me so much that I simply had to write and congratulate you on a truly fine magazine.

Gay Jeryzycki
Joliet, Ill.

In Florida too!

You stated that the two-footed worm lizard *Bipes biporus* ("The Lizard That Looks Like a Worm," May '64) is found only in Baja California. I'm sorry Florida has them too.

Charles M. Fletcher
Branford, Fla.

Charles M. Bogert, Chairman and Curator of the Department of Herpetology of the American Museum of Natural History, says he has checked reports that the rare reptile was also found in Florida. All he was able to find were salamanders that looked somewhat like the two-footed worm lizard but were, in fact, amphibians.—Ed.

Fluoridation

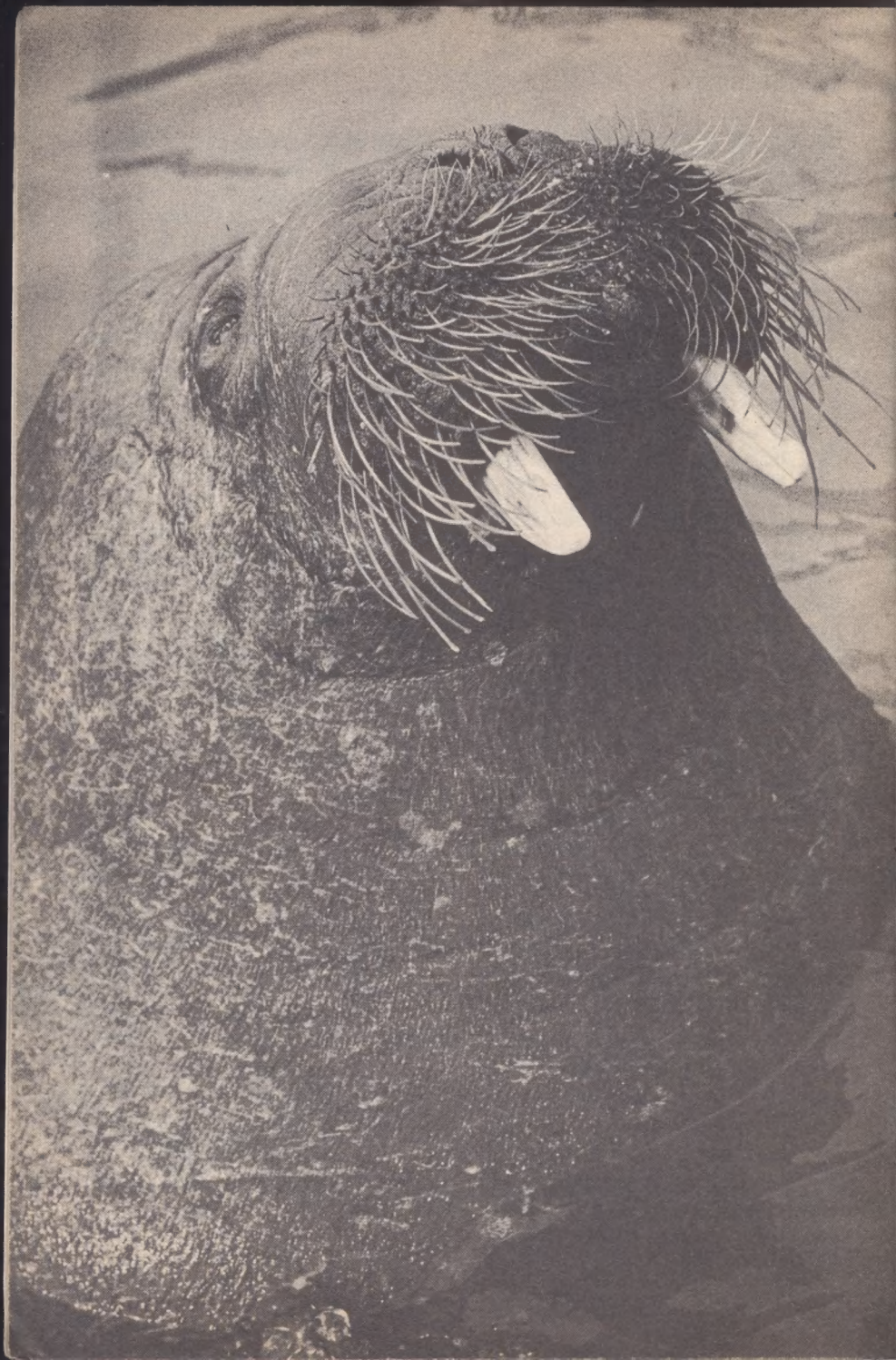
Congratulations on the excellent side-by-side coverage of recent developments in the fluoridation issue (April '64). The New York story shows what political intimidation can do.

Mrs. Edith F. Elliot
Portland, Ore.

Strange companions

Regarding your article on the dangers of solitude for space travelers ("Solitude—Who Can Take It and Who Can't," Mar. '64). Insects in the cabin and space suit would break the monotony.

Theodore B. Dufur
Los Angeles, Calif.



Olaf, the front man

by Bruce H. Frisch

"HEY, big and ugly."
"Hey fatso."
"Hey, lover-lips."

The crowd around the pool at the New York Aquarium threw insults at Olaf the walrus, but they loved him for his good-natured ugliness. Few realized that Olaf is a front man, supported by a cast of frolicking seals and sinister sharks, for a going scientific concern.

Olaf himself does his bit for science doing what comes naturally.

"The least-known mammals are marine mammals," says assistant curator Dr. Carleton Ray. "We can learn a lot by simple observation. What they eat, how fast they grow, the sounds they make."

Seals and whales, along with bats, are the animals that best use sound to see, says Dr. Ray. A Weddell seal can dive 1400 feet and twenty minutes later find the way back to his hole in the ice. Last year, in Antarctica, Dr. Ray made recordings of their sonar cries. He has made recordings at the aquarium also, but in their pools the seals have less need for sonar. "We may try recording at night or clouding the water," Dr. Ray figures.

Of all the mammals, the Weddell lives in the coldest environment—under ice packs in the Antarctic. In the Bay of Whales, near where the aquarium's three Weddells, Mac, Murdo and Elsie, were captured, the sea water temperature is about 28.6° F. As uninviting as that sounds, seals may dive into the water for warmth, when it is cold and windy above. In Antarctica and at the aquarium Dr. Ray has been studying how seals and walrus keep their internal temperature constant in such frigid climates.

photos by Bruce H. Frisch

Olaf the walrus is a ton and a quarter of charm and scientific facts.

The ocean is dry

Like humans, the seal reduces circulation to the surface of his body to conserve heat in cold weather, only more so, letting the skin temperature drop almost to freezing.

He can do this because he has a thick, insulating layer of fat. A 1000-pound Weddell has three to four inches. A Pacific walrus has five to six inches. Fat is their fuel supply. Humans burn sugar, seals and walrus burn fat.

Besides heat the oxidation of fat yields water. "The ocean is very dry. You can't drink sea water," explains Dr. Ray. Animals in the ocean have to save every drop.

At low temperatures seals and walrus burn fat fast to keep themselves warm. At high temperatures the metabolic rate is slightly above normal, probably to provide energy to pump more blood to the surface of the skin where it can dump heat. In between there is an "ideal" tem-

Mayuk and Sapiunuk, one-year-old Pacific walrus, eat from a calf bucket. They have already reached 430 and 375 pounds on a daily diet of three quarts of heavy cream mixed with 20 pounds of blended clams. Eventually they will hit 5,000 pounds.

perature, where the metabolic rate is a minimum. It is surprisingly high, in the 50s.

Perhaps this is because the world has been warm through most of its history, Dr. Ray guesses. All animals were warm weather creatures first. Some have adapted to the cold in comparatively recent times. They can still get along in hot weather, while those that remained adapted to warm weather only will die in the cold. "People ask us, 'How can you take an animal from the Antarctic and bring him up to New York?' Look at them," and Dr. Ray pointed to the Weddells soaking up the sun. It was 84 in the shade.

Newborn seals have a fluffy coat of fur instead of fat to protect them from cold, but a baby walrus has neither fur nor fat. "The mother cuddles him to keep him warm," said Dr. Ray.

This summer Dr. Ray will begin measuring the metabolic rates of seals and walrus in a portable chamber.

As Dr. Ray spoke about seals and walrus, a burly man carrying an oscilloscope disappeared into the room behind the electric eel tank. He was Dr. Conradin Kreutzer from the Smith Research and Development Co., Lewis, Del.

Working for a group of fisheries faced with stiff competition from Peru, the company devised a method of attracting fish with electric impulses. The traditional way of

gathering a catch was for a gang of men to haul in the nets heavy with fish. Now electrical pulses lead fish in the nets to the mouth of a suction pipe.

Electric eels attract and stun food as well as knock out enemies with up to 400 electric pulses a second. Dr. Kreutzer wanted to compare the shape of the electric eel's pulse with the one put out by his fishing gear.

While Dr. Kreutzer set up his oscilloscope, Dr. Christopher W. Coates, director of the aquarium, lifted a lethargic, five-foot eel out of a storage tank and dropped it into the exhibition tank. Dr. Coates was wearing the kind of rubber gloves an electrician might wear to handle a live wire. He wired two electrodes to the oscilloscope, then dipped them in the water near the head and tail of the eel. The eel fired, and a squiggle appeared on the picture tube of the oscilloscope, drawing a satisfied "Aaah," from Dr. Kreutzer.

About 30 years ago Dr. Coates began investigating electric eels. He learned that they are about 80 percent tail, of which 60 percent is electrical. The biggest eels pack a 650-volt punch effective for about 20 feet. Babies stay with the parent until they are six inches and 300 volts long. This is the minimum voltage effective for protection. It is enough to stun small animals like frogs, fish and mice.

The fresh water in the Amazon and Orinoco rivers of South America where electric eels live is a poorer conductor of electricity than sea water. Thus the electric eel puts out a high voltage to overcome the resistance of fresh water, and the torpedo and skate that live in the ocean discharge a higher current and lower voltage. To reach a high voltage the electric cells in the eel are connected end to end like dry cells in a flashlight. Like a flashlight he is long and skinny. The cells of the skate are connected in parallel, so it is broad and flat.

"We just wanted to find out how fish work. After we found out, the neurologists came in," says Dr. Coates. It had turned out that the electrical apparatus of the eel was made up of bundles of large nerve cells. Instead of using the electrical impulses in the nerve cells to send information to the brain or commands to the muscles, the electric eel combines them into a weapon and a lure. Neurologists like electric eels, because these cells are so big and have such a high output that they are easy to work with.

Stock of eels

Today the aquarium keeps a stock of 500 to 600 electric eels for Dr. David Nachmansohn at the Columbia University College of Physicians and Surgeons. Dr. Nachmansohn and his associates have used them to find antidotes for nerve gas and for pesticides that attack the nerves.

While the electric eel is hurling lightning bolts at his prey, other marine animals are "stinging or sending out poison or counteracting

Dr. Christopher Coates gathers a 600-volt charge of electricity from an Amazon River eel in a study to help fishermen.

poison," says Dr. Martin Stempien, Jr. "It's chemical warfare." Together with Dr. Morris H. Baslow he studies these toxins and other chemicals of waterborne life in the lab of the Department of Marine Biochemistry and Ecology headed by Dr. Ross E. Nigrelli.

The sea cucumber, for instance, when attacked throws out its guts and with them a poison. It makes red blood cells burst, blocks nerve transmissions and stimulates the heart. The final effect is uncoordinated spasms. The Japanese eat sea cucumbers, but during cooking the poison is leached out by the boiling water.

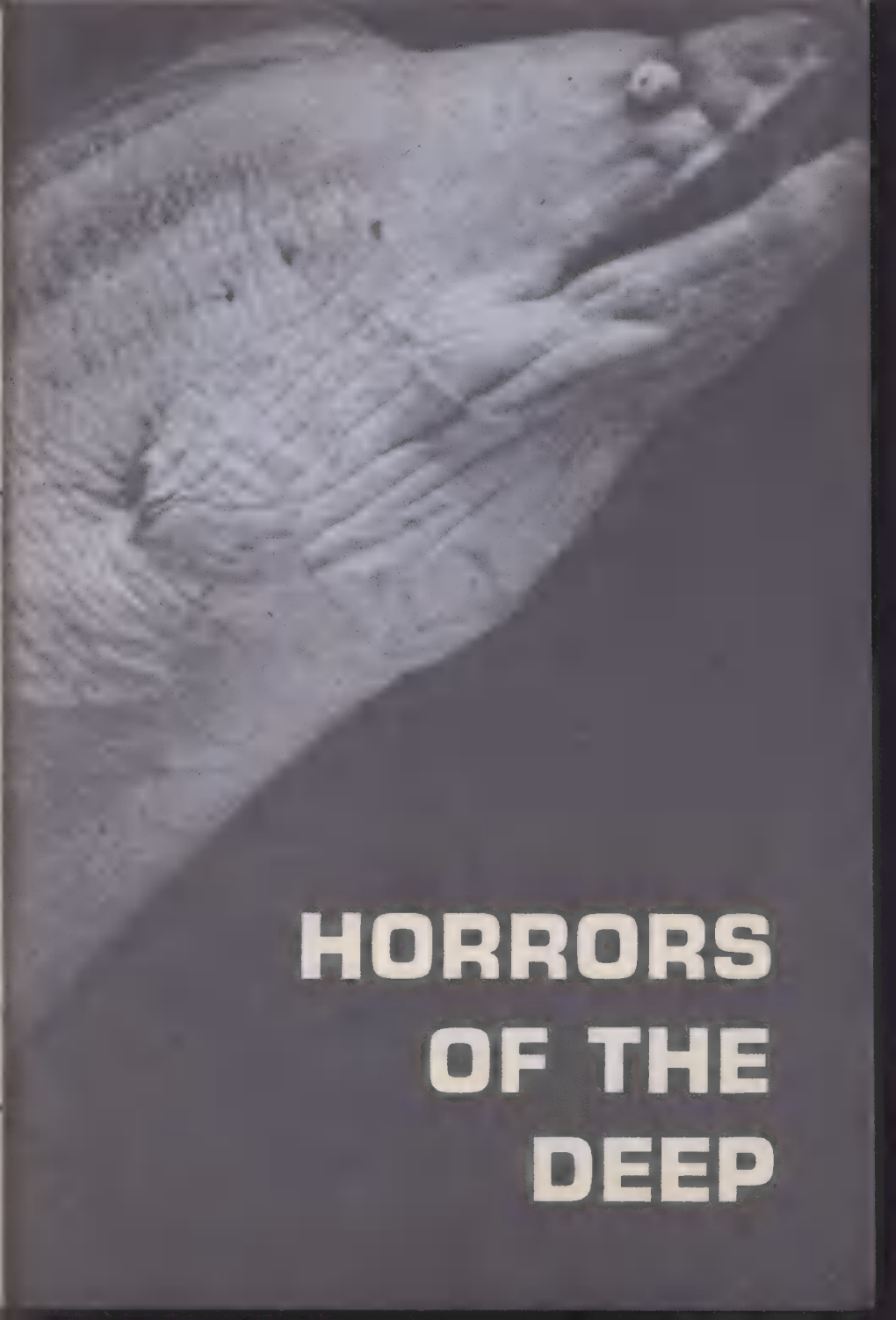
Octopus salivary glands secrete a paralytic poison. An octopus rasps a small hole in a snail shell, injects its poison and picks the paralyzed snail out to leave the shell clean. "Octopus are great for making shell collections," suggests Dr. Stempien.

Working with these toxins has its hazards. Both Drs. Stempien and Baslow have had asthma-like attacks from histamine in sponge concentrates. So far the lab has tested over 60 species of sponge, most from the Bahamas. They are dried, powdered and made up into solutions which are checked for killing power against the bacterium E. coli and for their effects on fish. If a sponge shows potency the lab tries to isolate and analyze the active chemical and test it against a wider range of organisms.

When a new lab is completed next door in late 1965, Dr. Nigrelli will expand his work at least ten times. This is a far cry from the wartime years when the whole aquarium consisted of a 20x20 room in the Bronx Zoo's lion house.

Nigrelli is also house doctor. Around the lab are bottles holding small fish and bits and pieces of larger marine animals bobbing in formaldehyde waiting for an autopsy. Here is where Olaf, in death, will make his last contribution to science. We hope the diagnosis is old age.

Not all sea creatures are as engaging as Olaf. A rogue's gallery of aquarium residents appears on the following pages.


HORRORS
OF THE
DEEP

Photos Bruce H. Frisch

Octopus (above) tied in ■ knot among the rocks, tries to look inconspicuous by changing color. Nighttime brings it out to hunt for crabs. Catfish (below) has feelers out as it cleans the bottom. Spines protect its soft, unarmored body. Lionfish spreads his poisonous mane of spines with which he seems to slowly sail among the coral reefs.

Shark (above) is hunted in Greenland, where it is turned into meek cans of dog food. Far Eastern fishermen are more respectful of the moray eel (See page 11). There's less to the porcupine fish (below) than appears to the eye. In danger, it puffs an inner bladder full of air to make itself look more formidable—and too large to swallow.

Today's scientific revolution is rapidly changing the world into a place that can be wonderful, confusing or even terrifying. One thing is certain—we must educate our children to live with conditions radically different from those we faced when we were growing up.

In response to this challenge, the Walden School, one of the oldest progressive schools in the country, called a conference on "The Nuclear Scientific Era: The Child and His Education," as principal focus of its 50th Anniversary Celebration.

Leading scientists and educators addressed the confer-

Can emotions

THE history of man, in particular Western man, makes this question a poignant one. It is a history replete with inhumanity: war, cruelty, exploitation, missed opportunity.

In the midst of the first World War, a war many had predicted would never occur, a weary and heart-sick Sigmund Freud wrote in "Reflections on War and Death": If we are to be judged by our unconscious wishes, we ourselves are nothing but a band of murderers. . . ."

In his view, man is innately aggressive and this primitive aggressiveness, though it may for a time be deflected from its primary aim, cannot be altered in its basic nature. It remains a fundamental determinant of behavior, awaiting only the proper psychological circumstances to burst forth from confinement; hence, war.

A decade later, in "Civilization and Its Discontents," Freud stated: "Civilization is perpetually menaced with disintegration through this primary hostility of men towards one another . . . the tendency to aggression is an innate, independent, instinctual disposition in man. . . ."

The Freudian view generally has incorporated the doctrine of aggressive instincts embodied in a timeless, changeless unconscious.

ence on problems ranging from nuclear war to automation. One of the most stimulating speeches was given by Dr. Leon Eisenberg, Professor of Child Psychiatry, The Johns Hopkins University School of Medicine. Dr. Eisenberg took up the topic of human emotions and human nature. Many believe that man is basically aggressive, and this will ultimately lead him to destroy himself with his new and powerful weapons. But is this really so? Is human nature immutable? Or can emotions be altered to fit new conditions? These are the questions Dr. Eisenberg discussed. A condensation of his speech appears below.

be changed?

Freud's doctrine assumes that the aggressive instincts are man's heritage from his biological origins; that is, such instincts are to be found in all animals and hence in man. This thesis accords to aggression as a drive an existence independent of other biologic drives; as such, it is insupportable. There is little or no documented evidence among animals of killing and maiming in and for itself. Carnivores kill their prey for food, in self-defense, in pursuit of territorial or mating rights, but not idly or for "pleasure." Indeed, it would be difficult to conceptualize an adaptive value for such behavior. Even if such phenomena can be shown to exist in an occasional species, their very exceptional nature is what requires explanation. That is to say, although the capacity for aggression is wellnigh universal, its display is evoked by specific circumstance; there is no evidence that it is activated by inner "needs" which require gratification per se rather than in the service of other goals for which aggressive acts stand as means.

A second argument advanced for the innateness of aggressiveness is its alleged appearance in children prior to extensive acculturation. Here we have yet another instance of a widespread tendency to substitute for the actual study of infantile behavior the mere a priori

The aggressive behavior of a child is partly dependent on the society in which the child is reared. Ours offers crime comics.

assignment of motives on the basis of spurious analogies with adult motivations.

In the normal child, aggression can be effectively understood in terms of the motives (defense, mastery, curiosity) for which "aggressiveness" is a suitable mediator. Its greater frequency in the abnormal child can be correlated with defects in the organism (as in the case of brain-injury) or with skewness in his environment (as in the case of faulty identification models, anxiety states, etc.). Moreover, the frequency of display of aggressive behavior is a function of the culture in which the child is reared. Aggressive fantasy materials (movies, crime comics, and so on), rather than affording "catharsis" for instinctual aggressiveness, generate the very tensions they profess to release.

Not all men are war-like

It has been contended that the ubiquity of aggressiveness in all human societies can be taken as proof of its innateness in man. This error is possible only with an ethnocentrism that takes Western man as the prototype of all men. Quite to the contrary, there are cultures in which war-like behavior is almost or entirely unknown as well as others in which war is the common state. If we adopt the position that groups which fail to display aggression have "only" repressed its expression but continue hagridden by its force, then we are beyond scientific discussion, for such a theory "explains" any and all facts and will not admit of a critical test.

To destroy or to cope

All active behavior is labelled aggressive. The label is then taken as sufficient to represent the source. In so doing, this argument reflects the ambiguity of everyday language in which aggressive is defined at one and the same time as "assaultive, violent" and as "energetic, vigorous." Surely, there is a world of difference between as assault intended to destroy and a vigorous effort to cope adaptively. To argue that the latter is but a "sublimated" equivalent of the former is to substitute mere verbal prestidigitation for detailed behavioral analysis. It is on this basis that Freud postulates ". . . an innate independent instructual disposition . . . the love of murder . . . a primary hostility of men towards one another. . . ." All the thesis lacks is evidence to substantiate it. The *capacity* for aggression is indeed inherent in the biological organization of man, as it is

in all mammals; its displays are, however, conditioned by other determinants, some of which, at least, have been identified and can be modified by appropriate learning.

The same dichotomies have been carried over into neurophysiologic models of the brain. Since evolution has proceeded by husbanding its resources, making old structures serve new functions, and adding new brain atop the old, a view has emerged which maintains that the new brain, like the conscience, sits astride the old, checking its excursions only at the cost of constant vigilance. Thus, physiologists talk of a "visceral" brain in which the "emotions" are supposed to be localized; and instinct theorists take this to be the anatomic confirmation of their psychologic speculations. There is, however, only the grossest of similarities between, say, the automatized rage reaction or abortive sexual behavior which can be evoked by stimulation of an isolated brain structure and the sublety and adaptiveness of the full display in the intact organism.

The changing brain

Brain regions like those in lower organisms are altered significantly in both function and structure as the brain evolves into new levels of complexity. The newly attained system of relationships between parts (and altered parts at that) changes the function of subordinate units in important ways. Their archaic characteristics are to be seen only when super-ordinate control is damaged by experimental intervention or by disease.

However, the tender-minded belief that man is by nature noble need not detain us. However devoutly to be wished for, it is even more devoid of confirmation and no less vulnerable to the criticism that it infers the existence of inner motives not independently demonstrable. What, then, can we say about the development, stability, and changeability of human emotions?

Emotional differences

The following generalizations about human behavior must be accounted for in any acceptable theory. Groups of people reared in different cultures by and large differ in what events evoke which emotional displays; this applies with equal strength to contrasts both between nations and between castes or classes within a nation. In almost every culture, there are differences in emotional expressivity which are related to sex and to age; thus, the tears so common in young boys are rarely permitted men in this society but may be tolerated in another or even expected in a third. There are equally remarkable individual differences. Moreover, emotional patterns are pliable in childhood and tend to stabilize into relatively fixed patterns at maturity, only to become unstable again in old age. For all the relative fixity at maturity, individual patterns can be altered by life ex-

periences, including the specialized procedures of psychotherapy, the definitions of which vary according to the culture. Finally, emotional behavior is frequently aberrant in the presence of certain types of central nervous system disease.

What general principles can be derived from this limited set of observations about emotional behavior?

Individuals differ in sensitivity to external stimuli as triggers and in response patterns once emotion is evoked. This is clearly so in the case of differences found in the presence of brain injury.

There is most certainly a maturational factor; the pliability of early childhood is gradually replaced by a consistent pattern of response that enables us to recognize personality types. It seems reasonable to suppose that part of this emerging consistency stems from neurological development, for it comes unscrewed again when brain function is impaired by senile change. It is certain that the major basis of stabilization emerges from learning, as the adult acquires the patterns demanded by his culture.

Learning to respond

Most significantly, emotional responses are learned. Comparison between societies makes clear a relationship between the values assigned to events by the culture and the emotions these events arouse in those who share its values. We learn what will make us sad and what happy, what will frighten us and what we will face stoically. We learn how we are to respond in the presence of certain feeling tones. And we learn what ceremonial acts will dispel the feeling when it is unpleasant.

From the emotional capacities common to all men, each culture molds a series of integrated patterns which make use of the universal elements in particular ways. The persistence of inter-individual differences does not gainsay the power of the cultural press. There are, after all, local idiosyncracies in the family and in the community which are the bearers of culture to the child.

The wide limits of change

Emotions can be changed, even as they are formed by the expectations society sets for its young. Changed and formed, of course, within the limits set by man's biological heritage, but those limits are extraordinarily wide, since man's most striking characteristic is his capacity for adaption. No social order will succeed in eliminating individuality, nor would a democratic order seek to do so; its domain is limited to removing the barriers to individual realization and to promoting flexible and adaptive responses to enable men to change as the needs of the times change.

The myth of immutability of human nature has served through the ages as an intellectual barrier to social progress.

Dr. William Spencer, right, and staff of Texas Institute for Rehabilitation and Research has developed new approach in merging men, machines and medicine to help difficult cases.

The computer that helps rebuild lives

Today computers are aiding doctors in treating people with grave long-term illnesses. Tomorrow they may be an important tool in all forms of treatment. Their use appears unlimited.

by Andrew Hamilton

It was a warm Texas evening in the summer of 1957. Dr. William Spencer, a friendly, heavy-set man, and his assistant, Dr. Carlos Vallbona, were walking across a parking lot in Houston. They had been taking a post-graduate course in computers and data processing — learning to use a new tool that might have value in medicine.

"We've seen how computers can be used in industry. Is it possible to utilize such devices on a large scale in medicine?" Dr. Spencer asked.

Then he went on: "Why can't computers be used to help correlate data from clinical research studies of various body functions and the sum total of a patient's medical, psychological and social problems?"

The question posed that evening by Dr. Spencer has since become

Electronic aids speed and increase the flow of information between patient and doctor. They can provide even unsuspected medical clues.

one of the most striking innovations in modern medicine.

Dr. Spencer was just the man to get the idea rolling. He is director of the Texas Institute for Rehabilitation and Research (TIRR for short), which is affiliated with Baylor University College of Medicine. It is a hospital-clinic-research facility that treats people with long-term illnesses such as polio, spinal injuries from automobile accidents, strokes, cystic fibrosis, muscular dystrophy and other catastrophic illnesses.

Today, the TIRR staff and many members of Baylor University College of Medicine's Biomathematics Research Facility and of the Departments of Rehabilitation, Physiology, Pediatrics, Physical Medicine and Orthopedics have instrumentation and computers working around the clock.

In so doing, they have found some ways to control and evaluate the tidal wave of data that is swamping most doctors and medical researchers — blood pressure readings, electrocardiograms, temperature charts, and so on.

The Houston doctors call their approach "medical humanetics" — a dramatic new approach to research, treatment and management of long-term illness and injuries.

TIRR is a modern, one-story building located in a park-like setting on the eastern edge of the huge Texas Medical Center in Houston. The first regional poliomyelitis respirator and rehabilitation center, established in 1950, is located at TIRR. The Vocational Rehabilitation Administration, which supports the computer work, has a regional research and training center housed in the Institute at Baylor University College of Medicine. Recently the U.S. Public Health Service, Medical and Hospital Facilities Branch, sponsored clinical information processing for research.

Some typical patients who have been treated are:

- An 18-year-old high school boy, paralyzed in an automobile accident and now in college preparing for a drafting career.
- A pretty young polio victim who has learned to type, dial the telephone, switch TV channels and paint pictures — with her toes.
- A 2½-year-old boy, a grotesque scrap of humanity born with no legs and only the stump of one arm. He lay on his bed motionless and speechless until doctors at TIRR taught him to sit up, feed himself and walk with artificial legs.

This new kind of hospital combines highly sensitive, modern instrumentation and IBM data-processing equipment to maintain fast and frequent checks on patients and groups of patients, and to pro-

duce a new kind of quickly retrievable health record.

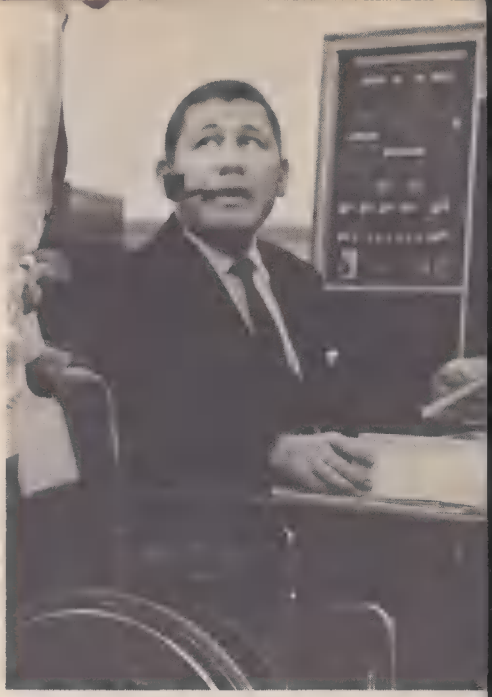
Baylor University College of Medicine's equipment consists of an IBM 1410 data processing system coupled to an IBM 1620 digital computer with random access memory, a graphic plotting equipment, and such ancillary equipment as key punch machines, a sorter and a collator. Sensitive instrumentation is used to detect and record bodily reactions. Then the information is converted to machine language for presentation to the doctor in precise, understandable form. Some 2,500 "bits" of information are collected on each patient, and some patients' records are 12 to 15 inches thick.

"By using electronic aids — collecting thousands of tiny pieces of data about a patient at his bedside — we are speeding and increasing the flow of information between the doctor and the patient," pointed out Dr. Spencer.

"As a result, we are coming up with more accurate medical clues and some we did not even suspect. This means the patient gets better treatment because it is ultra-precise and individualized. It also gives us a chance to anticipate what course the illness may take, thus minimizing certain danger points."

In rehabilitating the catastrophically ill, Dr. Spencer and his colleagues have become increasingly aware of the importance of psychological and social factors.

A patient's life pattern may be represented as a three-strand cord



An overwhelming mass of data on each patient must be collected. About 2,500 bits of information are collected for each. Records are sometimes 15 inches thick.

of behavior — the medical, the psychological and the social. At the dramatic moment of major illness or injury, these cords are frayed in a thousand different ways, and medical skill alone cannot rewind them. Instead, the problem becomes one of data collection, information processing and patient management, all of which involve the skills of many specialists and professional workers to provide the needed individualized assistance.

"Let me emphasize that this is not push-button medicine and that medical humanetics will not eliminate the physician," said Dr. Spencer. "If anything, we will need the well-trained man and his judgment-making capacity more than ever."

Medi-PERT teams assemble every week to assess patients' progress. They decide if a patient is ready for next step on the road to recovery.

In several years of trial operation at TIRR, medical humanetics has provided more than 100 "answers" to puzzling problems in rehabilitation medicine. Here is a sampling:

After a person has been paralyzed as a result of a severe industrial or automobile accident, when can his body be elevated to a sitting position?

It has long been known that an upright posture puts a severe strain on the hearts of paralyzed patients. Computer data at TIRR, however, provides these minimum times for tolerance of the upright posture: two weeks for leg paralysis and two months for loss of all four arms and legs. These deadlines can be speeded, however, if paraplegics and quadriplegics are put in an aviator's "G-suit."

Do polio and other paralyzed patients need an extensive program of exercise to rebuild wasted muscles?

Muscles need not be subjected to direct exercise to gain function. The action of "synergistic" muscles (muscles that work together) may also be helpful. Thus, for enabling a weak hand to gain function, exercise of the other hand might be more useful and practical.

Is physical disability the main factor in determining a patient's ability to resume his job or his role as head of a family?

No. In a study of more than 200 patients, psychological and social factors were found to be more important than illness alone.

A variation of PERT (Program Evaluation and Review Technique), the system used by many large companies to assess job progress and plan future steps, has been used at TIRR to improve patient care and rehabilitation. At TIRR it is called "Medi-PERT."

Here is how it works. Several Medi-PERT teams consisting of an attending physician, consultants, a nurse, a physical therapist, an occupational therapist, a medical social service worker, a psychologist and a vocational counselor convene each week to anticipate patients' needs. If it is time for a patient to be taken from the respirator, or if he is ready to wear an artificial limb, or to go home, members of the Medi-PERT team review his case. Information from the IBM com-

Computers can take over the drudgery of data-collecting, thus freeing physicians to spend more time to use their intellect and judgment.

puters often influences the decision.

"I suspect that in the future, very few of America's first-rate physicians are going to be satisfied with today's methods of diagnosis and treatment after they learn what instrumentation and data processing can do," says Dr. Spencer. "But I should point out that there are four mental hazards that should be avoided at all costs:

1. "Medical humanetics is not just another instrument like the X-ray machine or the electrocardiograph. It is a complex system of several kinds of instruments and organizational patterns to provide better care for the patient.

2. "Computers are not going to solve all of medicine's problems overnight. Computers plus instruments provide an extension to the physicians' intellect; they do not supply either the questions or the validation of answers in terms of the patient's circumstances. This still requires medical judgment and always will. Some problems can be attacked quickly, but others will take time — especially those in the psychological and sociological areas of medicine and health.

3. "Medical humanetics may decrease hospitalization costs for some but may increase it for others. It is doubtful, however, that America's annual $21,000,000,000 health bill will be reduced. But it will mean that most illnesses can be treated more effectively.

4. "Computers will never eliminate the physician or the art of medicine. However, by taking the drudgery out of data collecting, processing and synthesizing, computers will allow the physician more time to exercise his intellect and his judgment."

Only a few years ago when medical men and mathematicians gathered, they laughed politely at the notion advanced by Dr. Thomas P. Almy of Cornell University.

He suggested that in the future, when an individual was injured in a bad accident and could not be identified, all that would be needed was a fingerprint. It would be teletyped from the hospital where he lay unconscious to a central medical repository. In a split second the man's entire medical history would come flashing back and the doctors would treat him accordingly, with the certain knowledge that he was getting the correct blood type, antibiotics, etc.

"We don't laugh at this suggestion any more," says Dr. Spencer, "for yesterday's fantasy has become tomorrow's reality. Medical humanetics at TIRR and Baylor University College of Medicine is demonstrating how to bring it off by merging men, machines and medicine for mankind's benefit."

Bowling in the classroom

by Prof. Charles Randall
Ohio State University

SOME of the most beautiful and important phenomena of physics arise out of the mutual interplay between the law of conservation of energy and the law of conservation of momentum. There is deep meaning in the fact that in all collisions, even those in which kinetic energy is not conserved, momentum is conserved. The original momentum of the system remains unchanged in all interactions—in rocket propulsion, in completely inelastic collisions, and in creation of new particles.

Many years ago, I watched with rapt attention while my high school physics teacher lined up a row of identical steel balls in a straight groove cut in a board, then rolled another ball rapidly toward the end of the row. The rolling ball struck the row and the ball on the opposite end sprang into motion.

"What happens if two balls are rolled toward the row?" I asked.

"Of course two balls will leave the other end," and he proceeded to demonstrate that fact.

Years passed. I became a graduate student in physics. I used wires to suspend 10 steel balls, pendulum-like, to eliminate the rolling effects. They performed strikingly. But always the "stationary" ones in the middle moved a little, independent of the speed of the first collision.

Prof. Charles Randall demonstrates the law of conservation of energy and conservation of momentum with the aid of specially prepared bowling balls.

Why? Well, eighty years ago Hertz the physicist showed that the impact force between spheres depends upon the relative displacement of their centers at the time of contact.

If the balls are slightly separated, then the whole series of collisions can be reduced to a sequence of two-body collisions each of which can be solved uniquely. If the balls are all in contact initially then the elastic properties of the balls themselves enter into the explanation.

Now, as a teacher, I have found that experimental equipment to demonstrate conservation of energy and momentum must meet certain design aims. The Brunswick Corp. supplied seven matched, undrilled bowling balls. Two adjustable 9-ft. wires hold each ball so that the points of impact pass through the centers of the spheres. The wires hang from sliding tracks mounted on the ceiling so that the balls can be separated. Thus we can show the effects of collision when the balls are not touching as well as the conventional condition of just touching. And we can demonstrate that the number of balls moving after collision is always equal to the number moving before the collision. Such symmetry is preserved even if more than half the total number move.

Bowling can be fun as well as educational, even without pins.

"What a perfectly lovely smashup"

A flaming plane skids up a 55-foot hill and rolls down the other side, shearing off wings, propellers and landing gear. It was just what the FAA wanted—to make flying safer.

by Arturo F. Gonzalez, Jr.

Fire fighters warily moved in around the burning DC-7, snuffing out the aviation fuel which was searing through its badly smashed aluminum fuselage. Stretched out behind the battered aircraft was a trail of destruction, its propellers and landing gear sheared off by a pile of railroad ties; its left wing crumpled against a 25-foot high mound of dirt. Three telegraph poles had sliced away the tip of the right wing. The plane's wingless fuselage had skidded at a sickening 140-miles-per-hour up over a 55-foot hill; then the ship had rolled on its left side down the other bank. Inside its cabin, seats and safety belts had given way; passengers hurtled forward with bone-crushing impact.

"What a perfectly lovely smashup," murmured an aviation official standing at the end of the Deer Valley Airport outside of Phoenix where the violent crash and fire had taken place.

A surplus DC-7 gives its life in a violent 140-mph crash to test ways of saving the lives of plane crash victims. All "passengers" were rubberized mannequins.

The Federal Aviation Agency made an intensive study of the plane's smashed aluminum fuselage. More than three dozen electronic recording devices were aboard.

The official, however, was no sadist. This April 22 crash was indeed a "lovely" one, for it had been carefully planned and thoroughly engineered by the Federal Aviation Agency as a part of the most significant crash safety test in this country's history. The $29,000 surplus DC-7 had, in fact, been completely unmanned. Its engines were started by an engineer who deplaned before the aircraft started down the runway, its nose wheel guided by a railroad track, its engines remotely controlled to build it up to takeoff speed and get the plane airborne for a half second before smashing it into a series of carefully contrived barriers designed to duplicate obstructions which might fell an airliner just taking-off or landing.

Together with a second controlled crash of a surplus Constellation in June, this arranged accident has provided safety researchers with more information than ever before available on the tragedy of death in the air. The research is vitally important. Each year crashes kill 800 people around the world and experts say the total will be 15,000 annually by 1990 unless safety breakthroughs are made.

Who would have lived?

More than three dozen cameras and electronic recording devices produced masses of information on the plane's destruction. Most research interest revolved around the "fate" of a number of rubberized, steel-framed mannequins strapped into seats inside the plane. Sensitive

A new safety device, an inflatable plastic sack, might have helped some passengers survive the crash, the test showed.

acceleration devices hooked to these mannequins indicated whether or not they would have survived the impact of the crash.

After a careful, post-crash analysis it was decided that the co-pilot and pilot would not have survived the impact and would probably have been crushed to death. Another mannequin strapped into a side-facing seat was also probably killed because the seat belt broke under the force of the crash.

For many years, safety experts have insisted that backwards-facing seats would eliminate crash deaths. The findings after this crash did not back up this supposition. Three rear-facing seats failed to protect the mannequins, the backs of the seats snapping and the bodies slipping out from underneath their seat belts.

One interesting new safety device did cause a mannequin to "survive" the crash. This was the "Air Stop" designed by Martin of Baltimore, a new plastic air sack built into the rear and bottom of a standard passenger's plane seat. Inflated, presumably by the pilot who senses imminent destruction before impact, it expands backward in two sections covering the feet, the legs and the body of the passenger in the seat behind. This sack cushions the passenger against injury from impact, and deflates after impact to release the individual. Further tests are planned, but this device might well become the first major improvement in commercial airline passenger safety since the seat belt.

The FAA authorities were particularly interested in the effect of fire on the chance of passenger survival. In a study of 61 air carrier accidents over an eleven year term, Federal flying specialists have reached the startling conclusion that the fires which follow crashes — not injuries resulting from the actual impact itself—have killed 41 percent of all airline disaster victims. Only 4 percent were fatally injured by the disintegration of the plane's structure or by articles rocketing with skull-crushing speed inside the cabin. Two hundred and twenty-one passengers in these 61 accidents who suffocated or burned to death would have survived had there been no post-crash fire.

The importance of fire research is perhaps best demonstrated by an accident which occurred in Denver on July 11, 1961. The scene was Stapleton Field on a clear summer day and on the final approach was a jetliner with an inoperative hydraulic system. The plane landed normally but then inexplicably skidded off the runway, smashing into a truck and killing the vehicle's

driver. During the skid, three of the jet's four engines and its landing gear were torn away and a fuel fire broke out on the left side of the aircraft. All 122 passengers were alive and uninjured when the stricken aircraft finally came to a halt.

But then tragedy struck. When the stewardesses opened the emergency hatches to let the passengers out, thick, choking smoke poured into the cabin. There were three available exits in the first class compartment and all 41 passengers up front left the plane safely.

No way out for 16

In the rear, however, were 81 passengers and only one exit. Before the plane was completely evacuated, 16 of these passengers had died from smoke inhalation and carbon monoxide poisoning, waiting for their turn to crawl through that one tiny hatch. There were no signs in the aircraft pointing out to the passengers in the rear that they could go forward and leave through the first class emergency exits. The tiny aisle in the back was so narrow that the stewardesses could not lead the passengers who were panicky out the front way. No instructions had been given to the passengers regarding methods of getting out of the aircraft in an emergency.

And so, 16 people who lived through a crash died in the smoke of a fuel fire afterwards.

At Phoenix, the researchers went to find out how to prevent these deadly fuel fires. A number of alternate experiments are being carried out at the same time. One plan is to change the chemical composition of aviation fuel so that it turns into fireproof jelly on impact. The April crash tested this with unsuccessful results.

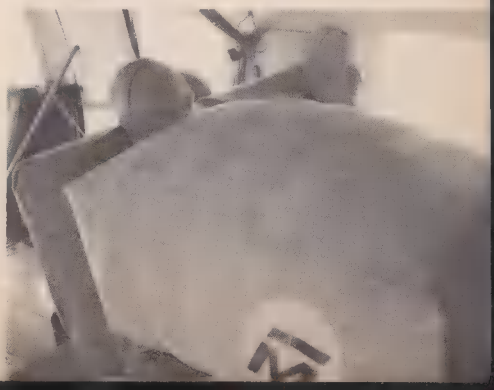
Another suggestion is to hang a plane's fuel tanks well outside the wings and fuselage so that they will break away on impact and hurtle far from the aircraft itself.

Still another plan is to make airplane engines "inert" at the moment of a crash so that they will not start the fires themselves.

This last suggestion does not seem feasible. Sparks from the engines dragging on the concrete runway are usually enough to ignite spraying fuel. As one safety expert has put it, "We'll have to create rubber airplanes to avoid this sparking problem."

Devices have been tried which automatically shut off the flow of fuel from tank to engine in an emergency. But many pilots dislike

A so-called "Air Stop," designed by the Martin Co., cushioned the crash impact of dummy passenger in test plane.



Ideally, a plane should be so designed, so says the FAA, that it can be emptied of all its passengers in two minutes or less.

these intensely, because the valves show a disarming tendency to operate in mid-flight, instead of only in emergencies.

Breakaway fuel tanks have been perfected. But these are so small that they are unusable for anything except very short duration flights. Certainly they are impractical for use on long-range jets which must cross oceans and continents.

The FAA has crashed and burned 10 surplus helicopters since 1960 in pursuit of knowledge of fire and the structural effects of crashes. "We have developed some extremely interesting information on helicopter fire problems," says Victor E. Rothe, manager of the FAA's research division, "the time it takes fire to burn through the skin, the buildup of gases, what gases they are and so on. It leads to better understanding of escape time problems."

The FAA wants all aircraft eventually to be designed so that a full cabin of passengers can leave the plane safely in two minutes or less. To reach this goal, the FAA may soon make it mandatory for all airliners to carry signs, visible from every seat in the cabin, which point the way to emergency exits. Planes may soon be forced to carry battery-powered megaphones for use by the cabin attendants directing an evacuation in an emergency. And plane attendants may soon be asked to give a small, pre-takeoff lecture on emergency exits before every flight. At present this is done only on flights going over large bodies of water and is usually coupled with a demonstration of how to use a life vest.

Another area of recent FAA research concerns the braking of skidding airliners on runways. The need for new technology in this field was driven home recently when three airliners skidded off rain-soaked runways in New York City on a single day — happily without passenger injury. The U.S. Air Force uses arresting gear at present and has stated that 250 military planes have been saved by these devices. The FAA wants to know why civilian airlines don't take a leaf from the Air Force book.

A hook for a plane

Halting the uncontrollable skid of a 150-ton airliner loaded with people is relatively simple. Three pieces of equipment are needed. The first is a taut, elevated cable across the end of a runway. The second is a steel tail-hook attached to the incoming jet's belly. And the final piece of equipment is a device that can absorb, gently and smooth-

ly, the huge quantities of energy released when a jet liner rolling at close to 150 miles an hour is brought to a swift halt.

There are two types of instances where such devices would be used. On takeoff, the pilot might suddenly find an engine on fire, a truck on the runway in front of him, or a flock of birds jamming one of his engines. If it were too late to abort the takeoff, he could drop his hook and be stopped by the arresting wire at the end of the runway.

Landing control too

Similarly, on landing, should the pilot find that he has landed too far along on the runway and is running out of concrete, the hook and arresting wire could again avert tragedy.

The main matter of debate at present is money. It will cost approximately $10,000,000 for the average airline to hang tail hooks on all its aircraft, and some hard-headed businessmen rationalize that this is a sizeable amount of money to spend to provide safety for a plane already on the ground.

Despite the grim nature of all of this crash and accident research, it should be noted that American civil aviation has just completed its third safest year in history. Aviation has indeed come a long way from just 50 years ago when a tiny, awkward, Benoist flying boat pulled itself from the waters of Tampa Bay and successfully wobbled 18 miles carrying passengers to a destination across the harbor. Although America's air transportation system has been revolutionized countless times since the days of the Benoist, there is one slogan which has never changed in the half century. Painted on the crude wooden shack at Tampa which housed this first commercial airliner was the hand-lettered battle cry "Safety first." The airline owners had the sign painted and displayed as a reminder that no matter what, safety was their motivating force. Now, 50 years later, it is still the number one concern of the scheduled airlines of the U.S. and the Federal Aviation Agency—both determined to make flying safer and more pleasant in the years to come.

For the birds

THERE are more penguins than there are people on the Falkland Islands a South Atlantic colony claimed by both Britain and Argentina. The islands, about 300 miles east of Argentina and surrounded by cold, choppy seas, have been under British rule since 1833, but the Argentine Government also claims them, says the National Geographic Society.

The drab, rocky land, not unlike northern Scotland, is an ideal spot for hundreds of thousands of birds. More than 120 species have been observed, including four varieties of penguins. Most of the birds live near the ocean and nest on precarious ledges overhanging the water.

A perforator was one of the many objects made from ordinary household articles.

Take 12 paper clips . . .

. . . and a few other ordinary objects and see how many things you can make from them. That's what a creative design class at Tufts University must do.

The assignment (below, left) and envelope of objects (right) resulted in the variety of devices shown on these pages. All were made by creative design students.

E.Gr. 22 ADVANCED MACHINE DESIGN (CREATIVE DESIGN)
(Spring Term 1964)

WEEKEND CREATIVITY PROJECT

OPERATION PAPER CLIP

This envelope contains the list of ordinary articles shown at right. You are to make use of as many of these articles as you see fit in creating something usable. Bring your device to class on Monday and give a demonstration of its effectiveness.

Time Allocated to Project ---------- 6 hours.

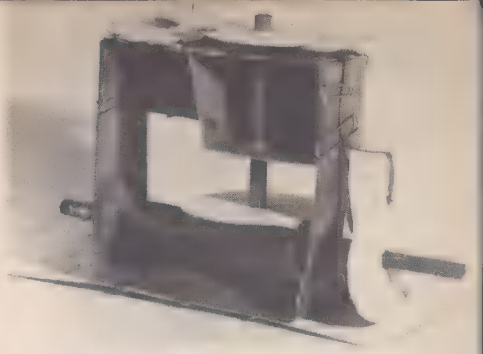
12 paper clips
1 razor blade
6 thumbtacks
2 safety pins
4 pencils
9 rubber bands
2 pieces of poster paper
1 piece of aluminum foil
4 flexible binding pins
1 large envelope container

THE Tufts University Department of Engineering Graphics teaches an unusual course. There are no formal tests or examinations, and the instructor participates in the seminar as a class member. It is an elective course in Creative Design for seniors.

At the first class meeting, instructor and students discuss the subject of creativity and explore some of the methods that promote personal creativity. The students are then assigned to build mechanisms with the paper clips and other elementary items shown on the opposite page. Students have one weekend in which to complete their projects.

As a follow-up, one class recently was given a transcript of an executive meeting of a tool and hardware company which decided that the cost of a $5 hand drill had to be reduced 20 percent to keep pace with foreign imports. The class met in executive session to discuss new design concepts and then each student was asked to come up with a new design, revolutionary if possible, within the next two weeks. When they came back to class, the students submitted their designs to a jury made up of faculty members.

The devices that have evolved from the paper-clips exercise are often ingenious. The students exercise an inbred talent for creating things that may lead to new products in industry when they become engineers. Their inventiveness is exemplified in the devices pictured here and on the following page.



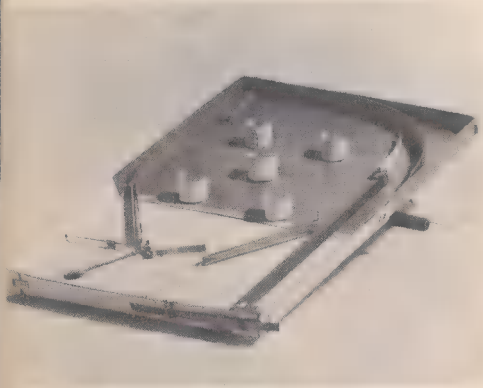
Desk Calculator

Record Player

Page Turner (above), Mouse Trap (below)

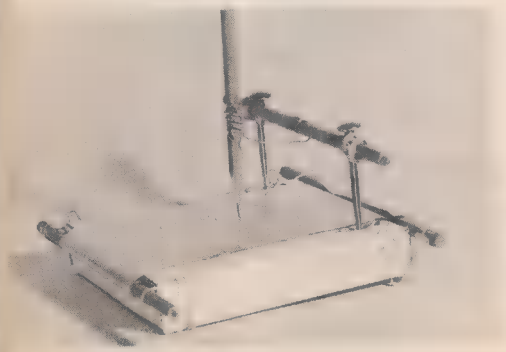
Scales

Electric Motor



Pinball Machine

Pump



X-Y Plotter

Electric Sander

WHY AFRICAN BABIES ARE MORE INTELLIGENT

Tests of African children in Uganda disclose that they are unusually developed, mentally and physically, even at birth. They are able to do things American and European babies can't do until they are much older. For the story, turn the page.

by Reginald Dean
and Marcelle Geber

We Europeans can seldom claim that our newborn children are physically active or mentally alert. They are helpless, spend most of their time in the curled-up attitude of the foetus, keep their eyes tightly closed, sleep many hours of the day, and wake only to announce their hunger and to satisfy it. Although they are perfectly normal and healthy, they continue in this way for several weeks. It may not be until the end of a month or so that their limbs remain outstretched for long periods, their hands are relaxed, and their eyes seem able to focus definitely.

In contrast, young African babies are often much more lively. They keep their initial advantage for a time, but usually lose it for reasons that are partly physiological, partly psychological, and partly the result of the limitations of their environment.

The European behavior is not universal, and we do not know whether it should be regarded as "normal" for the human race, or "abnormal." It occurs in populations of European descent in and outside Europe, but very little is known about the children of other races. However, studies have been made in Mexico and Senegal and we have examined the behavior of children in Uganda in a fair amount of detail.

A large proportion of the African children born in Kampala, the chief city in Uganda, have reached a stage of development at birth that is not attained by European children for several weeks. They lie in a comfortably relaxed attitude, they have an astonishing control of their heads, they often have their eyes wide open and follow a moving light intently. They suck vigorously until they are sated, almost from the moment of birth.

A well fed child

The ability to suck so well is undoubtedly one of the factors that insure the excellent growth of the African child during the first six months. He is superbly fed, and grows so well that, without being obese, he will often weigh more than a European child of the same age. He lives in constant physical contact with his mother, carried on her back when she is at work or walking, and lying against her, with one of her breasts close for his use, when he sleeps on the ground.

The mother devotes herself to the child and he prospers accordingly. He gives every sign of enjoying his position as the focus of the mother's attention, and of enjoying also the frequency and extent of his social life. He takes a lively interest in everything around, and is encouraged to sit and to stand much earlier than if he were a European baby. His toilet training begins when he is

For the first six months, African babies are far more intelligent than European tots. They excel to the age of 1. Then something happens.

still under a month old, and is gently persuasive, with no hint of punishment for failure.

The development of the child has been measured in Uganda and in Mexico by means of the Gesell test (See "How to Test a Baby's Intelligence," *Science Digest*, Jan. '64). This test, the invention of the late Arnold Gesell of Yale, is not supposed to be applicable before the child is about four weeks old: but in Uganda and Mexico the state of development at birth is so advanced that it can be used in the first weeks. The test consists of watching the use made by the child of a series of toy-like objects that provide tasks of increasing difficulty of complexity.

All the tests have a double purpose: to show the co-ordination of the body's ability and the development of senses and intelligence, and to judge the child's awareness of the outside world and the quality of his contacts with the world—his "social reactions."

The majority of the African children examined in Uganda belonged to the poorer families. The houses of these families are extremely simple. The mechanical devices that we take for granted—the handles that turn, the wheeled cart, the movable window—are absent, and there are no toys that would be recognizable to a European child. In these circumstances, the response of the African child to the toys of the Gesell test is all the more remarkable. He usually scores higher, in the first 12 to 15 months, than a European child of the same age.

In the next 12 months he often loses his precocity. He is much less lively, and may actually regress, so that he can no longer succeed in tests that used to be easy for him. He is more inclined to avoid social contacts than to court them. He goes into a period of mental stagnation, from which he does not emerge until he is four or five years old.

What is responsible for this sad loss of intellectual accomplishment? What turns the brilliant six-months-old child into the lacklustre, rather unjoyous three-year-old?

There are no grounds whatever for invoking a genetically-controlled process, or an innate inferiority. The reasons seem much more likely to be a change in the attitude of the mother to the child, the failure of the environment to afford the necessary stimulus to intellectual advance, and the imperfect nutrition of the child after weaning.

Weaning is a gradual process, but on a day arbitrarily decided in consultation with influential relatives, such as the husband's mother or sister, the breast is denied. Nowadays,

After they're 1, the babies are denied their mother's breast and sent away. That and the lack of toys stultifies their development.

with the calendar commonly understood and exact dates known, the first birthday is often chosen. The refusal of the breast does not seem to cause the child great distress. Possibly of greater importance than the physical loss is the mother's feeling, dictated by tribal custom, that the child is now old enough to look after himself.

These conditions are ideal for the production of "deprived" children. African children react exactly as do our own to insecurity, frustration and the lack of maternal feeling, and we think that much malnutrition has its origin in, or is accentuated by, the absence of the mother. At this point it is customary to send a child away from his mother to live with one of his "influential" women relatives. Even if the mother and the child are still living under the same roof, they may be separated, by the withdrawal of the mother's attention, almost as effectively as if the separation were geographical.

The poverty in material possessions is remarkable: a few mats for the earth floors; a chair for a visitor, a chief or the father; a curtain instead of a door between one room and another; no books, pictures or ornaments. There is a small separate house for the kitchen, and as cooking is almost entirely by the steaming of food in banana-leaf packages, the utensils are of the simplest kind. The only tool used for cultivation is a kind of mattock, and the earth is scratched, rather than dug. Food of a kind is so plentiful that no one bothers about the increase of yields, and it is only in very recent years that any idea of quality has become established.

The range of food in the diet is small. The chief staple is the cooking banana, and the other staples, in descending order of popularity, are sweet potatoes, yams and cassava: these are eaten with beans, peanuts and the green leaves of a few plants growing wild. Africans near Kampala also eat flying ants and a kind of grasshopper, but the supply is seasonal and uncertain. Meat of cattle is bought on weekends, once or twice a month; cow's milk is not a traditional food, goat's meat is festive. Eggs, which are taboo to girls and women, are usually sold, not eaten.

The unadventurous diet might be used as a symbol of the way of life:

Professor Reginald Dean is Honorary Professor of Clinical Investigation at Makerere College, University of East Africa, and Director of the Medical Research Council Infantile Malnutrition Research Unit in Kampala, Uganda.

Dr. Marcelle Geber is Director of the Child Guidance Clinics of Aisne, France.

strictly traditional, inexpensive except in terms of the women's work, and untroubled by extremes of season or climate.

There are now good main roads all over Uganda, and communications are constantly being improved: but an excursion outside easy walking distance is, for most women and their children, an expensive and unusual event. A visit to a Child Welfare Clinic is a considerable undertaking, and the excitement of the journey, and its opportunity for social contacts, may be as important to the mother as the treatment or advice we can offer for the children. Visits to towns are very special occasions, and there could be no conceivable advantage in taking a young child on them.

Little chance to play

The only toy seen at all often in the villages is an unshaped stick, or lump of wood that a little girl will carry in a sling on her back as her mother carries a new baby. Older children who happen to find a wheel may fit it with an axle, and run it along with a stick. Otherwise, there is nothing, and the idea that children should educate themselves from objects provided for their play has not yet arrived.

In such a way of life there is little to bring out the intellectual potentialities of the young child. His questions must remain unanswered, and he must be self-educated within a frame constricted to a degree that can hardly be imagined by a European. Intellectual stagnation seems inevitable, and a child who continues to develop rapidly must be a near-genius.

The results of the testing of the psychomotor development of young children in Mexico and in Uganda have been extraordinarily alike, despite the differences in racial origin, culture and staple foods. In both countries, the diet of the child at weaning is grossly inadequate, especially in protein. Nearly all the protein given to the child is vegetable, and evidence is accumulating that vegetable protein must be supplemented by milk, or some other good source of animal protein, if the child's body is to develop well in the second and third years.

Very often, the effects of the unsatisfactory diet are insidious, and pass unrecognized.

In both Mexico and Uganda, children develop the disease known as kwashiorkor. The chief features are a low weight for age, changes in the color and texture of the hair and skin, and swellings due to accumulations of fluid. The disease is responsible for many deaths, usually in children in the second and third years: it probably has multiple causes, of which the chief is a diet that contains very little protein and an excess of carbohydrate.

In the most severe form, the disease is accompanied by profound mental changes. We have studied these changes, using the Gesell technique, although in some cases the child's apathy and lack of interest almost prevented any calculation of

a score. The mental changes seemed to be temporary and, after dietary treatment for about two weeks, were entirely reversed.

We have also made a small number of observations on the children of well-educated parents who are living in untraditional houses, surrounded by stimulating materials such as books, radios, bicycles and motor cars. The observations have shown that the early precocity, although it cannot be fully maintained need not be entirely lost. Our results need confirmation on far larger numbers, but it is already obvious that any assessment of the mental capacity of a tribe or race is almost valueless without a definition of the stratum of society that has been examined. Much of our own work needs to be re-interpreted and repeated because we now have a better knowledge of our children's background, and a better understanding of the limitations of their environment.

The tests that are available do not only measure "intelligence." They record accomplishments that belong to the cultures in which the tests were evolved, and inevitably bear the imprint of those cultures. Their imperfection in this respect becomes more obvious in the tests for the older child than in those for the younger, and our own work on children more than four years old has shown us little more than the need for new tests, derived within the culture of the children who are to be investigated.

Can studies such as we have described contribute to the well-being of the people of the developing countries? We believe they can. The picture we have drawn is, of course, that of the uneducated, the intellectually deprived. It is a picture that will inevitably change, but in the meantime it sometimes seems to us that to obtain an internationally recognized qualification—or even to become eligible for university education—is almost a miracle in the face of so many disadvantages.

We have little right to opinions on what should be retained or encouraged, and what should be discarded or changed. We may point out, however, that there is a growing tendency in some parts of Africa to regard breast-feeding as unsophisticated, or even animal, behavior, and that a decline in breast-feeding without the means and the knowledge to provide adequate substitutes would be a nutritional disaster of a magnitude which would exceed any famine.

If we wanted to evolve a disturbed society, we would probably adopt the system of sending our children, at the age of eighteen months or so, to their grandmothers or their maiden aunts: and for an exact parallel, we would have to find grandmothers and maiden aunts who were fiercely old-fashioned, who had never been to school, who had a deep scepticism of the advantages of hygiene, antibiotics and arithmetic, and knew instinctively that a child should be fed almost exclusively on potatoes.

the progress of MEDICINE

How people react to pesticides

by Arthur J. Snider

LIVING less than 500 yards from the pesticide-sprayed fields, the home dwellers complained of odor and nasal irritation. A check by health authorities showed the homes indeed were frequently enveloped by drifting insecticide.

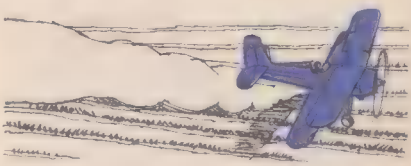
This provided an excellent opportunity to check the health hazards of insecticides to persons with incidental exposure since there has been much lay and medical concern regarding the toxic effects of insecticides.

A total of 122 volunteers in the exposed group were studied to determine how much of the chemical was absorbed and whether there were symptoms of insecticide poisoning or chemical intoxication.

They were compared with a similar number of city dwellers who lived far from the sprayed fields.

Results of the study "support the conclusions that the hazards of insecticidal poisoning are negligible," said Dr. Robert S. Ganelin of Tucson, Ariz., reporting in the *Journal of the American Medical Association*.

Differences in absorption between the city dwellers and those living near the treated fields were "small and not significant." Only one person, a farmer, produced laboratory evidence of intoxication and he had no symptoms of poisoning.



In the same issue of the Journal, a Chicago investigator reported that despite the increasing use of pesticides, people are not retaining them in the body in any greater quantity.

Dr. William S. Hoffman analyzed fat specimens obtained by autopsy

from 282 people known to have eaten vegetables and fruits sprayed with DDT and lindane, both chlorine-containing pesticides.

They found that regardless of quantity ingested, the body retains only a certain amount and eliminates the rest. "The most significant feature of the analytical results is that they indicate there has been no progression of storage of DDT in the general population since the first studies in 1951," Dr. Hoffman said.

Who should be in the hospital?

Hospitals appear to run a loose ship on admissions. From 11 to 24 percent of patients do not "absolutely" have to be there. Some of this slack could be taken up with a probable saving in hospital costs. But how much tightening-up society desires depends on how much of a safety factor we want without jeopardizing the patient.

These conclusions emerge from an in-depth study by the Health Information Foundation and the National Opinion Research Center.

A survey was made of a representative sampling of 2,046 patients discharged from 50 hospitals in Massachusetts over a one-year period. Patients were interviewed in their homes. So were the recommending physicians, and 72 percent who attended the patient in the hospital. All were asked a detailed set of questions to recreate the chain of events leading to admission and discharge.

On the basis of the data, Odin W. Anderson, research director of HIF, and Paul B. Sheatsley of NORC concluded:

"It is apparent that there was a gray area of 11 to 24 percent where decisions could have gone either way; that is, in-hospital or out-hospital treatment. If there were some way to screen out this gray area of admissions, it could not be proven that the public would be any worse off."

Cholesterol goes to the dogs

Pet dogs who live high on the hog develop the same kind of cholesterol problem as human masters whose diet contains too much fat.

Luxuriously-living pets of middle and upper class owners on Chicago's opulent North Shore had a blood cholesterol level 75 percent greater than a less fortunate element of the canine society.

The 160 privately owned dogs were compared with 156 animals kept in the cages of animal research quarters of two hospitals. The hospital dogs were maintained on a stock laboratory diet of commercial biscuits and dry bread, sometimes supplemented with horse meat. The diet was almost cholesterol-free.

Diet of the pets was known to the

veterinarians who cared for them. It consisted of a commercial dog food of low cholesterol content, plus supplements of "human foods," including eggs, meat and milk. Supplements had been ordered by the veterinarians to provide additional fat for the hair coat and additional protein for female dogs and young growing animals. The supplement increased the cholesterol intake of the dogs many fold—probably twice that of the laboratory dogs.

Elevated blood cholesterol could not be associated with any hardening of the arteries in the plush-living dogs, however. All were considered healthy.

Cholesterol was measured periodically when the pets were brought to the veterinarians for vaccinations or vacation boarding. The cholesterol level rise was comparable to that of a human being even though the cholesterol intake of the animals was less.

Saving a hand

By all medical standards, the right hand of Mrs. Jessie S. Bray was severed in the milling machine accident. It hung by only an inch of skin and two tendons when she came to the emergency room of an Indianapolis hospital. Surgeons' first thought was to snip off the little bit of remaining skin and make a clean amputation. But Mrs. Bray, a 39-year-old factory worker, asked if they would try to save it.

The surgeons then proceeded in the next five hours to stitch together eight tendons, three major nerves and two major blood vessels. When Mrs. Bray woke up, she was able to move her fingers. Nobody in the hospital would believe it until they saw for themselves. If recovery continues, doctors expect her to have the use of her hand with only slight impairment.

Only one case of a successfully reimplanted limb has been recorded before. Surgeons at Massachusetts General Hospital, Boston, attached the right arm of 14-year-old Everett Knowles in 1962 after it had been severed by a freight train. Feeling and partial use of the arm have returned.

Portable drug pump

Now it is possible to infuse drugs into a cancerous patient even as he goes about his work. The development of a portable infusor makes it possible to considerably shorten long hospital stays. The tiny device weighs only eight ounces and is worn around the neck like a miniature camera.

Dr. Elton Watkins, Jr. of the Lahey Clinic, Boston, says it permits prolonged and continuous exposure of the cancer to a drug, a necessity if the maximum effect is to be achieved. In the first six pa-

tients, each with a liver cancer, a tube was implanted into the hepatic artery feeding the liver. A concentrated solution of the drug, carried in a plastic bag, holding about 30 cubic centimeters, is infused at a steady rate of 4 to 5 c.c.'s every 24 hours by means of a miniature pump. The patient learns how to replace the bag and receives a supply of drug-charged refills. Once each day he winds up the clock-like mechanism controlling the pump.

Dr. Watkins said the patients showed a reduction in liver size, improved appetite and weight gain, and relief from pain and nausea.

Dr. Watkins expects to extend it to treatment of tumors of the head, neck, legs, cervix, and bladder.

Cut those calories

Americans are eating too much for the amount of exercise they get. Therefore, the Food and Nutrition Board of the National Academy of Sciences—National Research Council, has recommended another cut in daily calorie quotas.

For its "reference man," a 25-year-old, 154-pound American who leads a moderately active life, the board has recommended a cut of 300 calories to 2,900. For the "reference woman," a 25-year-old who weighs 128 pounds, the cutback is 200 calories to 2,100.

The board considers the former recommendation, adopted in 1958, to be too high now because the accoutrements of modern living, such as power mowers and automatic dishwashers, have decreased physical activity.

Three hundred calories, the board says, is about six pats of butter or an hour of golf.

Coughs in a crowd

People trying to hear a speaker will swear it happens more often, but a crowd of 100 people will cough about 2½ times a minute. Dr. Robert G. Loudon of Dallas, Tex., discovered this in a study to determine how often healthy people cough.

The number of coughs varied from week to week, depending on the season. Dr. Loudon also found there was a consistent and significant decline in cough frequency as an hour session wore on, indicating that the respiratory system acclimatizes itself to the environment.

Help for children's doctors

A new breed of medical personnel, known as pediatric doctor's assistant (PDA), would be introduced into the practice of medicine under a plan offered by Dr. William G. Crook of Jackson, Tenn. It would improve pediatric services which are

falling behind the demand by parents for more comprehensive child health care.

The PDA would work closely with the pediatrician but not actually practice medicine. One of her major responsibilities would be handling the telephone, screening calls, listening to parents, giving advice under the physician's supervision.

Another important duty, according to *Pediatric Herald*, would be to expedite the physician's recommendations for treatment.

Dr. Crook says studies show half to two-thirds of mothers don't follow advice or give the medicine as prescribed, either because they don't understand or don't know how, or are psychologically unable to accept advice.

The PDA would also follow up on the progress of acutely and chronically ill patients, would advise parents on "trivial" matters, such as routine feeding instructions, formula preparation, allergy elimination diets and care of smallpox vaccination.

More on cancer and viruses

"It would be too good to be true, but it could be true."

With these words, Dr. Albert B. Sabin, developer of the oral polio vaccine, disclosed he had discovered a virus in the thymus gland of an 18-year-old Cincinnati youth suffering from chest cancer. Tumor cells were extracted from the gland. The cancer cells lived and reproduced under laboratory conditions. The virus was unlike any other that has been described or encountered in human cancer.

"The evidence is only circumstantial," Dr. Sabin says. "I'm prepared to fall flat on my face on this. But it may be true that this virus has a casual relationship to certain kinds of cancer."

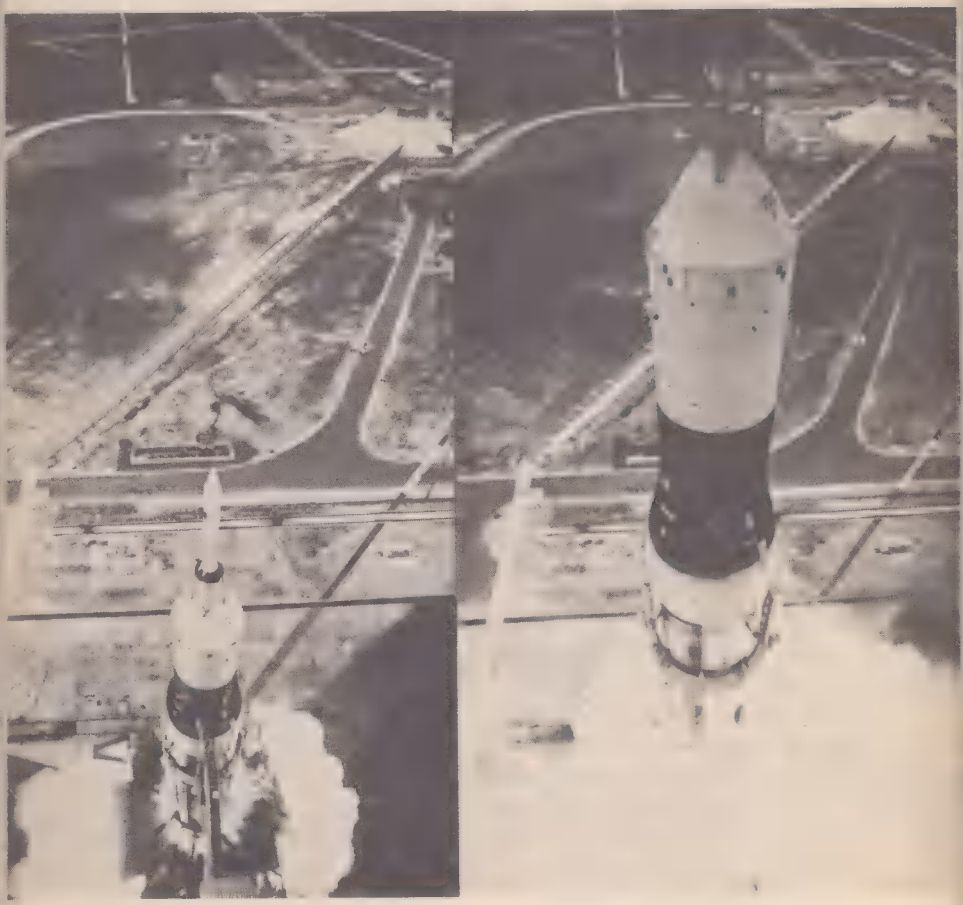
Viruses have proven to be causes of cancer in some laboratory animals but not to date in human beings.

Water skiing perils

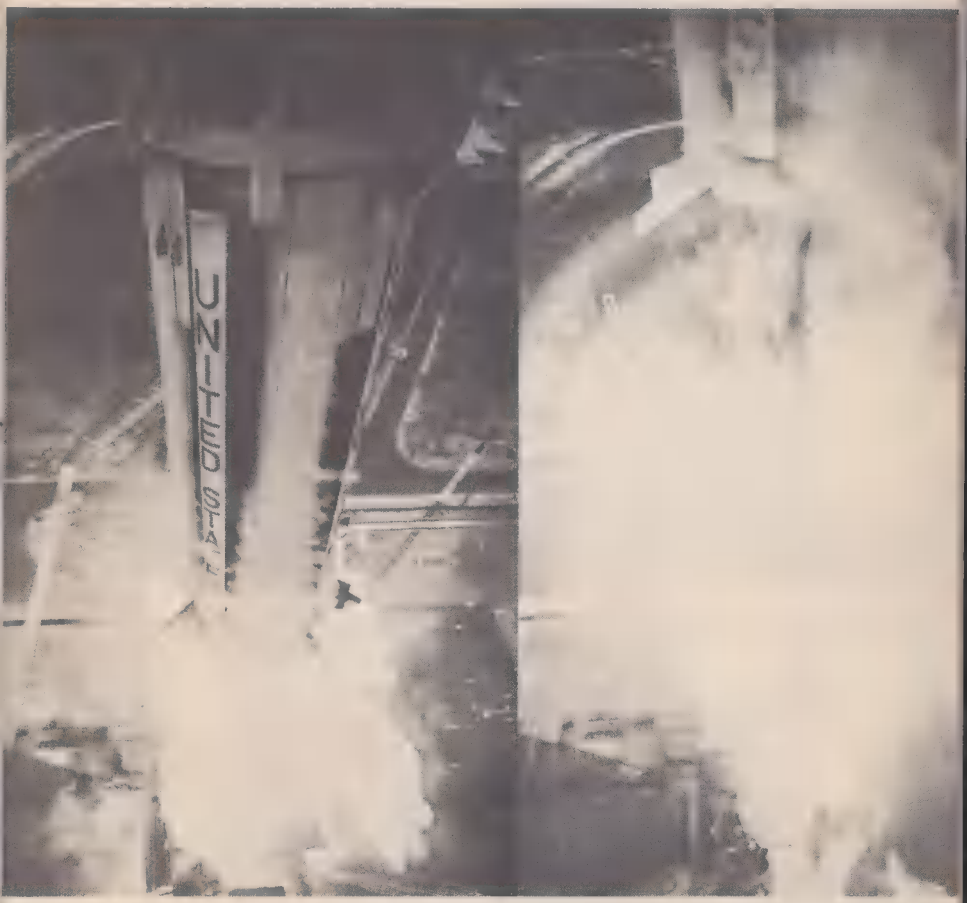
The young woman continued to have intense headaches and dizziness a month after she fell while water skiing. Examination by Dr. Ralph M. Stuck of Denver showed that she had suffered a brain concussion. He has since issued a warning to skiers that with the speeds becoming "fantastic," the water surface becomes more resistant.

"I suspect injuries at this speed on water could fracture bones as well as cause concussion," he comments.

A patient who had experienced several spills one day while learning to balance on one ski, later developed numbness in her left foot, then in her entire left side. It was necessary for her to give up water skiing.

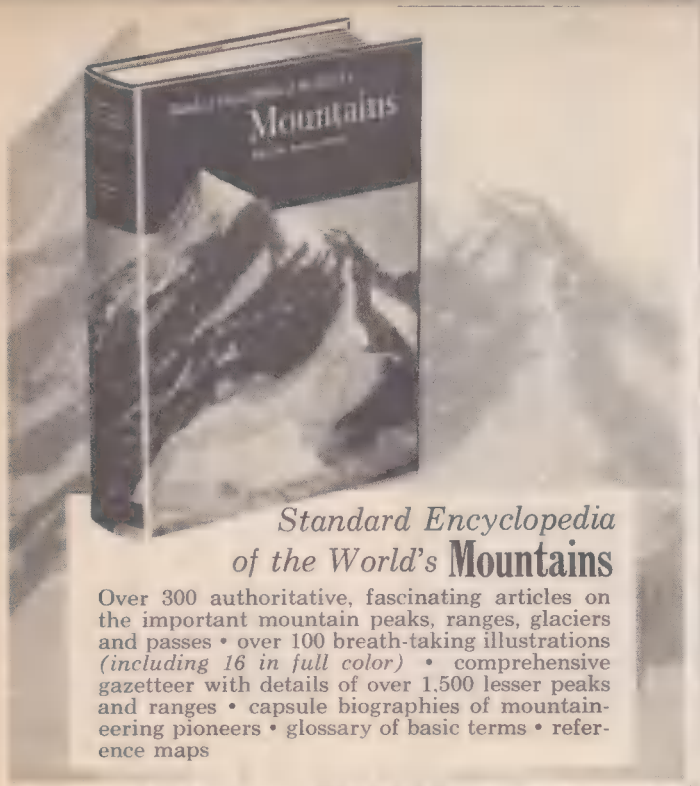


Bird's-eye view of a blast-off



NASA

These photos show the launch of an Apollo/Saturn rocket as a high-flying, suicidal sea gull might see it. The pictures were taken from a fixed camera position, atop the rocket's umbilical tower. A remotely operated 35 mm Nikon camera with a 21 mm lens was used to take the series. Atop the rocket were the Apollo boilerplate command and dummy service module and lunar excursion module. The launch took place at Cape Kennedy, Fla.



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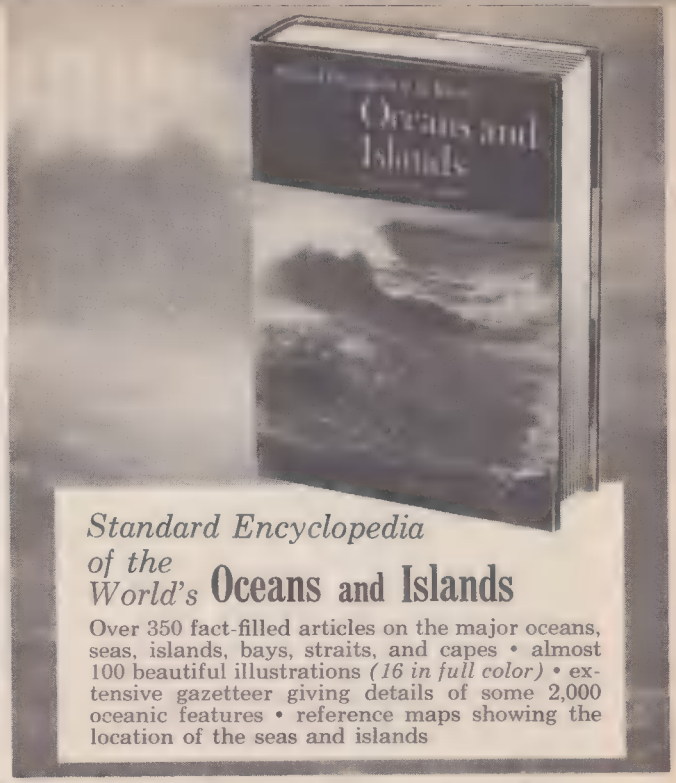

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CAN SCIENCE TALK TO PEOPLE?

The Hugh Downs Column

THE word *science* is constantly undergoing change of meaning. In bygone days, science was *practiced*—the science of alchemy, the science of the black arts, etc. The word has been identified with various skills from time to time, often having nothing to do with any branch of "science" as we think of it today.

In its pure meaning, *science* has to do with finding out. Through the last century and until recently, it came to be almost synonymous with technology. It was science that brought us faster cars and better medicines and long-distance dialing and the threat of nuclear extinction. When the word was used outside the context of technology, it had to be qualified (the science of mathematics, pure science or abstract science, pure scientific research, etc.).

The world's latest coloration identifies science with the sinister.

This idea began to show up in 19th century science fiction with its accounts of strange engines and experiments operated to questionable ends by villians of pronounced emotional torque, and later in the grade C movie plot laid in the mad doctor's basement laboratory and spiced with way-out sexuality.

All of which hinted with spare subtlety at scientific secrecy and danger, and the fact that it bore constant watching by those not on the inside. All the same, there was no real gap as long as the hero could change a couple of wires and, through sheer red bloodedness if not intellect, outsmart Bella Lugosi into

turning his equipment's fury on himself instead of the girl. The audience was titillated but took comfort in the obvious conclusion that anyone with a little time could figure out what the mad scientist was trying to do and how.

The "that's way beyond me" attitude of the layman didn't really bloom until William Randolph Hearst chose to make Einstein's General Relativity front page news. Probably the most unsettling piece of information to come out of that was the subsequent disclosure that not more than twelve (count 'em) men in the world were capable of grasping even the least notion of what Albert was talking about. That ripped it. Hadn't we always suspected that them there science fellers were straying farther and farther from the campus of common sense and developing a jargon unintelligible to John Q? The Lay Public (meaning everybody but the twelve above mentioned men) got a nasty turn, and some of them outright bridled.

Mankind's ivory tower

Still the bulk of mankind adopted the less wary attitude that whatever heady fumes came from their ivory towers, the theorists could work no harm so long as their ideas were applicable to matters trillions of miles distant or millions of years ago. (A science fiction editorial of the mid-thirties described in some detail the fissioning of uranium 235 atoms, concluding that it would forever remain impossible of accomplishment.)

The real breach came about, of course, when the fruits of scientific theory guided research into a sudden and rapid series of direct effects on all daily lives—not only dire effects but good ones, not only the atomic bomb but penicillin, not only nuclear contamination and DDT poisoning, but the Salk vaccine and the weather satellite. Now invisible tentacles from the ivory towers became evident and absent-minded old pedagogues with chalk-dust on their poor-fitting suits were seen in a shocking new light. They were movers. More than politicians, more than industrialists.

Science for the layman

So science had a public relations problem, which could be solved by re-establishing faith in its potential control and understanding by the layman. Hardly a hopeful solution, since the layman will steadily be less able to understand science—not more.

Hopeful voices are raised, such as that of Jerome Ashmore at Case Institute of Technology who sees, along with humanists like Sir Julian Huxley, a future reconvergence of purpose (and a certain amount of method) of science and the humanities. He points out the split is not rooted in reality but only reflects concentration on each end of a polarized entity. Mankind tends to partisanship, which finds its strongest expression in duality. Heaven

Where are the topflight theoretical scientists who will write a book the public can read? Science, Hugh Downs says, has laryngitis.

and earth, spirit and flesh, good and evil, white and black, Republican and Democrat, up and down, right and left reflect the structure of our thinking more than the nature of our world.

"Man has five senses to gather acquaintance with a minute part of the infinity of vibrations occurring in nature," says Ashmore. "He has a moderate power of understanding to interpret what those senses may bring to him; and he colors his interpretation with an irregular and passionate fancy.

Symbolic knowledge

"These endowments of man's mind are not altered by the direction in which his impulse takes it. Moreover, whatever the constitution of the universe, science and the humanities end with the same kind of knowledge about it, that is, symbolic knowledge. But there is only one truth and, within the limits of each, both science and the humanities attain it. They have a common origin and a common destination. Both are consequences of minds composed of the same psychological elements, reacting with the same external universe, generating the same kind of knowledge, and ending with the same truth."

Has modern science put all its eggs in a basket woven of inflexible methods? These methods have not failed to enable man to manipulate his environment, but as answer-seeking devices they are a complete bust. Most of the answers prove perishable and every answer brings two new questions.

Today's right-thinking scientist may say it is not science's proper role to pursue answers to philisophic and metaphysical questions. What then? To move on out into the ever-widening periphery of ignorance seeking to consolidate, control and exploit? With less and less concern for the non-scientific mass of humanity which may benefit from an occasional new vaccine, but whose mystification breeds fear?

Perhaps, if pure science is purely amoral, we'd do well to redouble our efforts to couple it to the humanities and thereby give it a head and conscience.

To do this, it will be necessary, not to educate every layman in every discipline, but to reinforce the rickety bridge of educational interchange between science and the humanities (which C. P. Snow feels has caved in) so that the layman may feel he is not totally out of touch with science and the scientist need not feel ashamed of being human.

Can science talk to people?

The secrecy and unintelligibility of some data make quite a block in

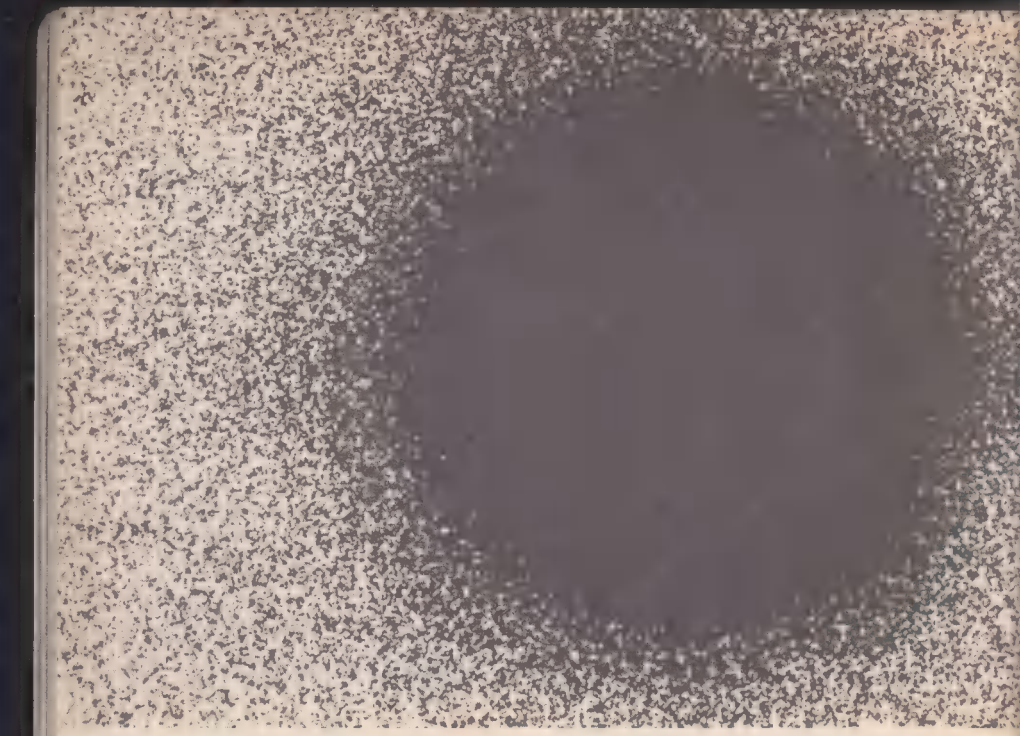
communication and it is still fashionable in some scientific circles to snub the popularizer.

Where are the Eddingtons and the Jeanses? I'm not overlooking the science editors and research writers who do a conscientious job of digging to put across in understandable form some scientific accomplishment or idea. I mean where are the topflight theoretical scientists who will write a book the public can read? They are too busy, their material is too abstruse or would suffer through oversimplification, they fear the scorn of colleagues, they are forbidden for security reasons to divulge things, and they gaze with despair at a chasm between their work and the public much wider than it was in Eddington's day. Science has a touch of laryngitis.

Every good thing in arts and letters has contained an element of popularization. The greatest writer in the English language was understood by the lowliest of his audiences at the Globe Theatre in London. Shakespeare was not afraid of being accused of popularizing.

Let's encourage the effort.

"Have you noticed how everything tastes better outdoors?"



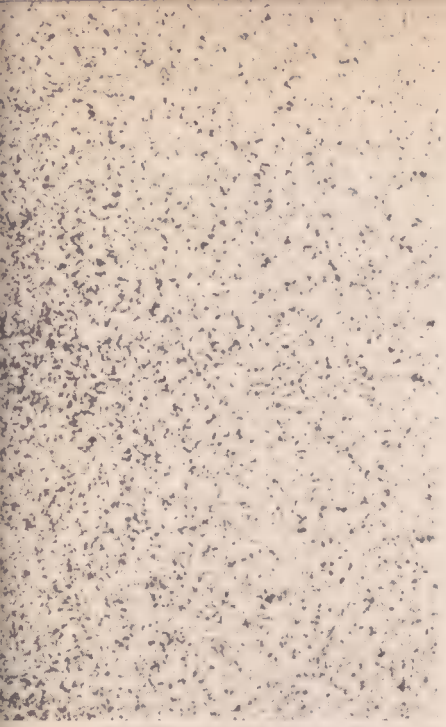
THE AMAZING NEW OBJECTS IN THE SKY

Astronomers are opening new windows to the stars. Some of the things they are seeing are challenging our basic ideas about the structure of the universe.

by Bruce H. Frisch

THE astronomer until recently has been a one-eyed man in a universe it takes a dozen or more eyes to see. His one eye could see visible light, but was blind to the whole rest of the electromagnetic spectrum that stretches from gamma rays to long radio waves. Since World War II and especially in the last few years, astronomy has suddenly blossomed out with a battery of new sharp-eyed instruments. They have brought a flood of discoveries.

The most spectacular recent discovery is the quasi-stars. They are the most maddening, too, because we have had pictures of them all



From IBM Astronomia at Hayden Planetarium.
This is 3C 273. Its unexplained source of energy makes it one of the farthest visible objects in the universe. Here it is seen through the 200-inch Hale telescope.

along and never recognized them for what they are, the most distant objects we can see and, many astronomers believe, the most important astronomical development in decades.

In photographs taken by visible light, they look like ordinary dim stars in our own galaxy, the Milky Way.

On sky maps drawn with radio telescopes, they showed up much brighter and more important, but astronomers still didn't recognize what they had. The images given by the radio telescopes were too fuzzy.

A radio telescope 200 feet across shows a quasi-star as a blob covering dozens of possible sources. The definition given by a telescope depends on its size and the wavelength of the radiation it focuses. Visible light has such a short wavelength, about one-half of one ten-thousandth of an inch, that even small telescopes give a detailed picture.

Bigger radio telescopes

The radio map the astronomers were working with was recorded in wavelengths longer than three feet. That is why larger and larger radio telescopes are built, not so much to pick up fainter and fainter radio waves, as to increase resolution. Even today's radio telescopes can reach beyond the limits of the 200-inch Hale telescope at Mt. Palomar. But for a radio telescope, working with wavelengths around three feet, to have the same resolving power it would have to be half as wide as the earth.

So astronomers turned to interferometers to shrink the blobs. These are instruments with two antennae separated so that a light wave from any point in space reaches one slightly ahead of the other. The two signals combine in a pattern that is highly sensitive to direction. Optical interferometers are a few inches apart. Scientists at the British U. of Manchester separated the antennae of their radio interferometer by 75 miles.

Other radio sources were pinpointed by Australians using the 210-foot Parkes radio telescope near

Before the telescope, astronomers sighted stars with instruments like this astrolabe. Navigation and astrology prompted the search for more precise methods.

Sydney. They aimed at a source and used the moon as a camera shutter. As the disk of the moon passed in front of the radio source, it cut off the reception in an instant. Correlating the time of cut-off with our precise knowledge of the moon's position gave positions accurate enough to guide astronomers at Palomar to two specks on photographic plates. They were faint inconsequential stars with the Cambridge catalog numbers 3C 273 and 3C 48. This itself was exciting, because all previously identified strong radio sources had been galaxies. This prompted a closer look.

The light from 3C 48 was spread into a spectrum, a rainbow with dark gaps and bright lines. Gaps represent cold molecules of a particular element which, in the atmosphere of the star, screen out certain wavelengths. Bright lines are the light from hot, glowing molecules of other elements. The lines of 3C 48 didn't seem to make sense. A more stretched out spectrum revealed more lines, but they were just as puzzling.

Two years passed. Then Maarten Schmidt of Mount Wilson and Palomar took a look at the spectrum of 3C 273. Its lines were just as puzzling but fell into a more familiar pattern. If only one group of four lines were located 16 percent further toward the red end of the spectrum, they could belong to hydrogen. Such a shift toward the red would mean 3C 273 was flying away from earth at over one-tenth the speed of light. The velocity stretches the light into longer, redder wavelengths, just as a jet plane flying away from a listener stretches the sound waves of its roar into a deeper rumble. In our expanding universe where every body outside our local group of galaxies is speeding away from us at a velocity directly proportional to its distance, this amount of red shift would put 3C 273 about two billion light years away.

How far to a quasi-star?

Another of the 25 quasi-stars now known, 3C 286, has been estimated by Dr. Iosif S. Shklovsky of the Sternberg Astronomical Institute in Moscow to be ten billion light years away. American astronomers would place it only six billion light years away. However, still another quasi-

star, 3C 147, now appears to be seven billion light years distant. At thirteen billion light years, a body would be travelling so fast no light would come to us and it would disappear. Nevertheless, this is the interpretation of the red shift most astronomers accept, even though it leaves many unanswered questions.

Last December scientists gathered at a world meeting in Dallas to consider one of the puzzlers: Where does the light come from?

At billion of light years, an ordinary star would be too dim to see. 3C 273 must pour out the energy of a trillion suns, or of 10 to 30 of the brightest galaxies, and has probably been doing it for a million years. Theorists considered several possible theories, including mutual annihilation at the meeting of matter and antimatter, and the simultaneous explosion of 100,000,000 supernovae. They paid most attention to the gravitational collapse theory suggested by Fred Hoyle of Cambridge University and William Fowler of the California Institute of Technology.

They picture a super star with the mass of a million to a billion suns. Under the right conditions, it would contract until it was so dense that the forces that normally limit further contraction would be overcome by the force of gravitation. The collapse that would follow would feed gravitational energy into an immense explosion.

The pulsation of 3C 48 and 3C 273 leads to another mystery. 3C 273 varies in brightness over a 13-year cycle. Yet it is about 3,000 light years broad. How can it go through a steady pulsation in a fraction of the time it takes any signal that could control it to pass from one side to the other?

While they pose many questions, studies of quasi-stars should answer many more, particularly about the formation of the universe. If the expanding universe is run in reverse, it seems to have originated in a point about 13 billion years ago. In quasi-stars we may be seeing objects old enough to be sufficiently different from present bodies to suggest how the universe began.

Waves from Jupiter

Radio astronomers point their telescopes at our nearest neighbors, too. In 1955, they picked up powerful bursts of low frequency waves coming from small areas on Jupiter. An early theory was that volcanic eruptions shook the atmosphere, making electrons vibrate radio waves into space.

Two physicists later suggested that Van Allen-type belts around Jupiter act like a maser. The sun slowly stores energy in the belts by raising the energy level of electrons. Then a rain of solar particles triggers a cascading of the electrons to a lower energy level. The slowly stored energy is quickly released in big chunks as radio waves.

The newest explanation comes from Dr. James W. Warwick of the High Altitude Observatory in Boulder, Colo. His idea is that the

magnetic field of Jupiter is off-center. This would bring the electrons in Jupiter's radiation belts swooping low enough to strike the thin atmosphere and excite radio emissions.

After six years of watching the radio spots rotate in step with the planet, Prof. Alex G. Smith at the U. of Fla. found them suddenly lagging behind by 1.3 seconds a day, which he said "is almost as surprising as if the city of Washington had begun to drift across the surface of the earth." If the radio spots are tied to the surface—which is hidden under clouds, so no one is sure—this means the planet itself has slowed. For such a massive object to slow so suddenly would take a huge and unknown force.

The earth's own belts

One thing physicists hope to learn by studying radio Jupiter is how the earth's own radiation belts function in order to make manned space flights safer.

To help solve such mysteries a broad array of new radio telescopes are being built. The Soviet Lebedev Institute of Physics has a 72-foot-diameter dish for receiving wavelengths as short as eight millimeters. The University of Texas has begun work with a 16-foot dish for picking up wavelengths down to one millimeter. This is down in the heat wave region, so that one thing these telescopes will do is take the temperature of the planets.

Operating on short wavelengths requires much more precise construction than for the more well-known giants such as Lebedev's 20-acre cross. Two kilometer-length rows of towers at right angles carry the antenna wires. The energy-gathering power of the antenna is measured by its area; the resolving power is measured by the length of its arms. The Australians B. Y. Mills and A. G. Little first devised this method of more economically gaining resolution, and astronomers have called this type the mills cross. They have named the Soviet telescope the Red Cross.

Crosses cover the longer wavelengths; dishes, the shorter wavelengths. The largest completely steerable dish, 250-feet across, is at Jodrell Bank, England. The U.S. Navy spent seven years and $63,000,000 trying unsuccessfully to build one with a 600-foot diameter at Sugar Grove, W. Va. West Virginia has had to settle for a 300-foot antenna steerable only in the north-south direction, but still the world's largest movable dish.

An even larger dish swung into action this spring, although the usual creaking and clanking was missing. The antenna is a 1,000-foot diameter section of a sphere fashioned out of galvanized fencing and anchored into a hollow among the hills near Arecibo, in northern Puerto Rico. Hanging over the center, suspended from three towers around the rim, is the energy collector. By shifting its position the dish can be aimed up to 20 degrees off the vertical. The collector does

double duty as a feeder, for this is the world's largest radar set.

Radar reached the moon in 1946, Venus in 1961, and last year Soviet scientists waited one hour and six minutes for a pulse to make the round trip to Jupiter.

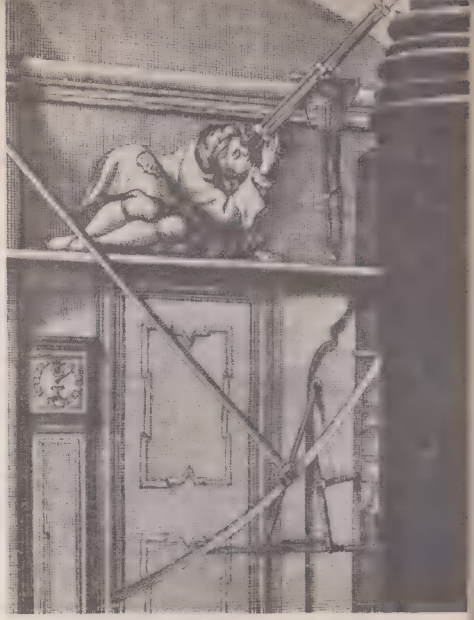
Arecibo began by tracking Mercury through a complete revolution around the sun to more accurately fix its orbit. Radar can also measure the distance to the sun, moon and planets, and gauge the speed of rotation of the planets, plus the tilt of their axes.

A different kind of radar, a laser light beam, has measured the moon. A Bell Telephone Laboratories scientist has reported that laser pulses bounced off the moon showed it is as much as 20,000 feet from a crater lip to floor.

Many more kinds of radiation carry information about the universe to us across trillions of miles of space only to run into our blanketing atmosphere in the last few thousand feet. The seemingly transparent air is as opaque as a brick wall except for a small window that lets in visible light and a second small window that lets in radio waves.

The buffeting currents

Even in visible light, swirling air currents so bend the rays the window seems to be made of wavy glass. The solution as Dr. Martin Schwarzchild of Princeton U. saw it was to balloon a telescope above our obscuring envelope. In 1959 he sent his Stratoscope I to 80,000 feet where a remote-controlled telescope took the most detailed pictures ever obtained of the boiling surface of the sun. He followed this up last year with a 36-inch telescope study of Mars. Mars seemed to have some water vapor, but not much, and CO_2.



Galileo followed the Dutch in building a telescope in 1609 and turned it to the sky. This version was of cardboard and wood, and enlarged 30 times.

Taking recent ground-based observations into account, Dr. Gerard P. Kuiper, who heads the moon and planets lab at the University of Arizona, told a spring scientific meeting, "There are no trees on Mars." Nothing larger than microscopic life is possible. He pictured a Martian atmosphere of two parts nitrogen to one part carbon dioxide plus small amounts of argon, oxygen and water vapor. The water appears as high cirrus, or ice crystal clouds

Stanford U.

Radio astronomy began in 1932 when K. G. Jansky traced one kind of radio static to the sun. Wartime electronics made possible big scopes like this one at Stanford U.

and as frost around the winter pole. When the temperature rises above 95 below zero F during the Martian spring, the frost sublimates.

Balloons launched from Fort Churchill, Manitoba, last summer dispelled some of the mystery of cosmic ray origins. Electrons and positrons were sorted out before they hit the air and precipitated the shower of secondary particles that finally reaches earth. Their ratio points to supernovae, exploding stars, as the source.

X-rays can't penetrate closer than about 50 miles from earth, too high for balloons. So, in 1962, the Air Force had to launch an Aerobee rocket when it wanted to learn about the surface of the moon by measuring how solar X-rays make the rocks fluoresce. Under a full moon the rocket roared 150 miles above White Sands, N. Mex. It radioed back word about a new x-ray source near the Constellation Scorpius. A second source, one-seventh as strong, showed up later in the Crab nebula, the remains of a supernova touched off in 1054 A.D. The next year a Naval Research Laboratory rocket fired from White Sands more accurately pinpointed their positions. When telescopes on earth were swung toward the source in Scorpius, nothing was there, just as scientists expected, because they think they have caught their first glimpse of neutron stars.

Thirty years ago neutron stars were predicted, but were unconfirmed, because they are invisible. The theory is that a massive, dense star explodes in a weeks long flash

as bright as 200 million suns. The explosion packs the remaining core even more densely until electrons are crushed onto protons and only neutrons are left. The Scorpius star may be ten miles in diameter and weigh one billion tons per cubic inch. It burns more fiercely than red hot or white hot. It is x-ray hot. As it grows older it may cool down to ultra-violet hot and then show faintly blue.

Astronomers figure an x-ray telescope won't be practical until there is a manned orbital observatory, an idea that may not be as far-fetched as it sounds. An unmanned Orbital Solar Observatory (OSO) was launched in 1962 and tripled the amount of information we had on the sun's x-ray output. Another went up this year.

An Orbital Astronomical Observatory six times as heavy is under construction. Its first job will be to draw a sky map in ultraviolet light.

But astronomers are still learning how to squeeze more information out of old, familiar visible light. A new telescope at the Yerkes Observatory of the University of Chicago will map the magnetic fields of the Milky Way by measuring how light is polarized as it passes through dust captured in the lines of force.

In a way this is one of the strangest new eyes of all, because it isn't simply seeing an invisible form of radiation, but is making visible magnetic fields that give off no radiation at all.

New eyes for the astronomer are constantly being developed and improved. We can expect even more spectacular discoveries in the future.

Daytime lights for autos?

Two researchers from the U. of Indiana's Division of Optometry feel that cars should display running lights in the daytime as well as at night. They base their recommendation in part on figures showing that the use of headlights at all times on Greyhound buses had decreased daytime Greyhound accidents by 11 percent. An improvement of 24 percent was the result in the Canadian Division of Greyhound.

Drs. Merrill J. Allen and James R. Clark, the two scientists, point out that some cars manage to blend in with their background so much that they become camouflaged to the point of zero visibility. Two-toned cars create a particular hazard, they warn. Perhaps the least dangerous are light-colored cars. "Some light-colored cars are up to 40 times more visible than some dark-colored cars. Cream to white-colored cars are usually six times more visible than darker colors."

The two doctors estimate that 2,000 fewer persons would have been injured in auto accidents last year if cars had been using daytime lights. The doctors' findings appeared in a recent issue of *The American Journal of Optometry*. Intensive research done by the two men was sponsored in part by Indiana University and the American Optometric Foundation.

YOUR SCIENCE ABC's

Measuring

THE FOUNDATION OF SCIENCE

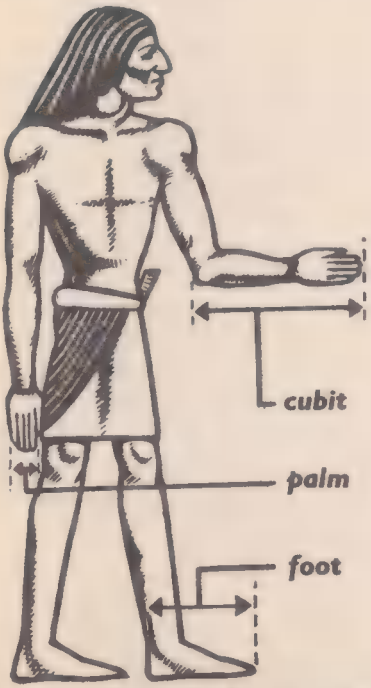
In early days, men attributed such events as the change of seasons, the growth of crops, the weather and disasters, such as earthquakes, to the actions of good and bad gods, whose good will had to be obtained by religious rites or magic, if crops were to be good. Man had little understanding of the forces of nature, and had not yet taken one of the first and most important steps toward understanding things. He had not yet learned to measure sizes, shapes, distances, weights and times —measurements without which there could be no science. Under certain circumstances, however, sheer necessity forced men to begin making measurements.

From the very earliest times the River Nile was a serious problem to those who lived on its banks. Every year the great river overflowed, and the Egyptian farmers and land-owners who made their living by cultivating the river-side land were faced with the task of reclaiming it after the floods subsided. The ancient Egyptian priests had to help and advise the inhabitants in order to avoid the many quarrels over land division. It is believed that the science of land measuring, or geometry, began on the shores of the Nile with the methods which were used to mark or measure the land to avoid these quarrels.

Measurement is really the foundation of physical science, and much of the science of physics is devoted to this purpose. In this science, instruments, appliances and machines have been invented for measuring. We are all familiar with the ruler and the tape measure for measuring lengths, but it took a long time to agree on exact measuring standards. In the Bible we read that Solomon's temple was measured in cubits. A cubit was the distance from the top of a man's

middle finger to his elbow, about one foot! For smaller lengths, the digit was employed. This was the width of a finger, about ¾ inch. Sometimes a distance called the palm was used, and was the width of the hand, about 4 digits. These units arose out of the size of bodily measurements, and as these varied with different folk, there was no really accurate standard.

The English system of measurement grew out of agricultural work, and the grain of wheat gave rise to the weight system: 32 grains made 1 pennyweight and 20 pennyweights were called an ounce, and 20 ounces were 1 pound. Several changes were made in the pound, but in the reign of Henry VIII the pound in use today was made legal. Three grains of barley corn placed end to end were called one inch, and 36 inches placed end to end were called a yard. It is believed that the idea of the yard started with the length of the arm of King Henry I. This was called the "ell." However, it was not until 1878 that the standard yard was adopted as the distance between two lines on a metal rod kept at a steady temperature. The foot originally was the length of a man's foot, a unit of length used long ago by the Romans. Since three of these measured approximately a yard, measuring was simplified by having the standard "yard" divided into three equal parts, each part being a foot.



The origins of measuring have come down to us from ancient times and were first used by farmers.

English measurements

Other English units have their origin in agriculture. The furlong was the length of a furrow, and the pole, the length of a ploughman's stick, which was needed to urge the oxen forward.

The scales and measures in use in the U.S. are regularly tested by inspectors from the local governments. Look at the scales in a store, and you will find that they have the stamp to show they have been approved by a bureau. The inaccurate weights and measures in the market places of villages and towns,

centuries ago, led to many quarrels.

The metric system came into use after the French Revolution which began in 1789. A committee of French scientists decided that it was best to fix a unit of length which would not be lost, or destroyed. To this end they measured and calculated the distance from the North Pole to the Equator and divided it into 10 million parts, each part being called a meter. The metric system is a system of tens, as the name itself tells us. Ten centimeters are 1 decimeter and 10 decimeters make 1 meter, and so on. A metal rod of 1 meter is kept at a certain temperature in Paris, and is the standard meter.

Metric system weights

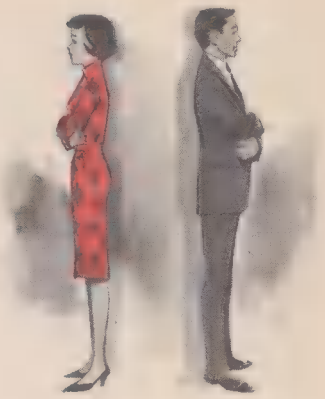
The standard of weight in the metric system is the gram, and it is the weight of a cubic centimeter of water at a temperature of 4°C. The decimal, or tens system, is employed in the metric weight units. We cannot explain it fully here, but we may know that 1,000 grams is called a kilogram, just as a thousand meters is called a kilometer. The metric system is easy to use, and because of this, it is adopted for many purposes in science laboratories throughout the world.

We all know that the two hands of a clock make what is called an angle with one another, and that this angle changes all the time. Look at the angle between the clock hands at 2 o'clock. This angle is the same as an equilateral triangle. The ancient Babylonians took this as their unit of angle measurement, and divided it into 60 equal parts which came to be known as degrees. In the 12 hours of a clock, 60 degrees occur between every 2 hours, and so there are 12 divided by 2 times and 60 or 360 degrees in a clock. Some of us may know that each degree is divided into 60 minutes (not minutes of time), and each minute of angular measure is divided into 60 seconds (not time seconds). Very important and valuable instruments cannot be used without a knowledge of angles, and angle measuring. Among these are the compass, for navigation, the sextant for finding positions on the earth's surface, and the protractor, theodolite and plumb line for surveying and building. Other measuring instruments are too numerous to mention. The thermometer measures temperature, and the barometer, air pressure. These instruments and many others depend upon accurate scales for measuring. Speeds are measured by how fast distance is covered.

Weights are measured generally by levers, such as store scales, or by spring balances. The amount of bone, flesh, and matter in our bodies is measured by our weight. Forces like those caused by wind and water are measured by their equal in weight.

The secret of success in this atomic age is the development of the marvelous instruments whose working depends upon very delicate and precise measuring.

Are you a prisoner in your marriage?



INSIDE PSYCHIATRY TODAY

by Flora Rheta Schreiber and Melvin Herman

ARE you a prisoner in your marriage? The answer is yes for too many couples. Their jailer is aloofness and they are caught in what ethnologist Gregory Bateson has described as "the prisoner's dilemma."

Typically, couples so trapped are like two suspects for a major crime who cannot know whether the other will tell all. They therefore are constantly suspicious of each other. Neither, moreover, trusts the other to trust him. Both retreat from displaying any affection towards the other for fear of a brushoff. Both maintain a false front, playacting at marriage rather than living it, for fear of being caught off guard.

This dilemma, which originates in the inhibitions and unresolved conflicts of courtship, can permeate and cripple every aspect of a marriage. It places husbands and wives in a paralyzing deadlock so deadly that they are unable to make even simple decisions. Though they are sexually attracted to each other and feel mutual affection, they cannot trust each other to accept any sexual or affectionate move at face value. They are, moreover, no more able to express their love for their children than for each other. The children become as suspicion-ridden as their parents.

Love may be blind, but love, seen through the haze of the prisoner's dilemma, is even blinder. Blithely unaware of her own shortcomings, a wife will see only her husband's aloofness; he, in turn, sees not his own, but only hers.

There are two ways out of the

dilemma, which Prof. Bateson investigated under the auspices of The National Institute of Mental Health, Bethesda, Md. One is through family psychotherapy and the other through determined self-help.

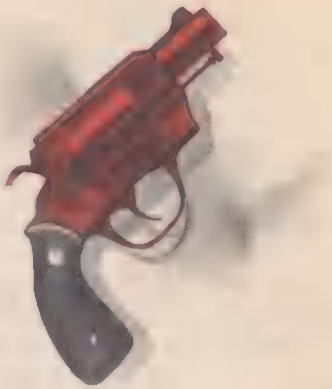
For one couple it began when Prof. Bateson asked a wife he was treating through family psychotherapy what she would do if a miracle happened and her husband, "cured of his aloofness," should run up the front steps and put his arms around her. Thinking for only a split second, she replied with a straight face, "I would be perfectly sure he had incurred some debts."

"You mean you would give him a brushoff?" the therapist reminded her. "It's not much good then, my curing him, is it?"

Shocked into awareness, this wife suddenly saw that it takes two to create marital aloofness and two to overcome it.

One young couple, however, acted just as effectively on their own behalf. Quarreling during a bicycle trip to Florida, they were on the brink of separation. The wife angrily pedalled away and the husband didn't follow.

Next morning, however, after a night of serious thinking while in separate motels, each started out in search of the other. They met on the road in an open and giving surrender. "By showing their strength," says Prof. Bateson, "to come out of the prison house of ceaseless sulking, hurt feelings and false pride, the cyclists reaffirmed a deep commitment to their marriage."



Why people can't take it

Twenty-one thousand persons in the United States will succeed in taking their own lives this year. And at this moment there may be as many as five million men and women in this country alone who have attempted to kill themselves. Suicide is our tenth major cause of death and the number of suicides is rising yearly.

The big question is: Why?

To find clues to suicide in the United States, Dr. Herbert Hendin of the Psychoanalytic Clinic of Columbia University went abroad. He felt that there were too many different ethnic groups in the United States to be able to discern a national character.

But in Denmark, Norway and Sweden he found marked national suicide patterns, each different from the other. Through psychoanalytic

interviews, employing free association, dream recall, and transference (the reactions to the analyst), all designed to bare hidden facts, he proved that this depth technique can lay bare national as well as individual truths.

In Norway there is a myth that wives are subservient to their husbands. Even the women themselves agree. But Dr. Hendin found that Norwegian women often dreamed of their husbands not as masters but as babies. When confronted with this seeming contradiction, the women admitted that men were not really stronger but must be allowed to feel stronger. Most of those interviewed said that their households and their mothers, as well, were the exceptions.

Neither men nor women commit suicide over this question of dominance. But in Sweden and in Denmark, where the suicide rate is double ours, and in Norway, where the rate is only three-quarters of ours, Dr. Hendin found many other psychological clues.

His most remarkable discovery was that in each one of the Scandinavian countries, the major motivation to suicide was different. This stems, he feels, from the differences in child rearing in each country. Also of importance are personal attitudes toward life, for example, the drive to succeed, and attitudes toward life after death.

In Sweden, where performance demands in terms of ambition and status-seeking are akin to our own, suicidal patients are found similar to those in the United States. In both Sweden and the United States, there are many men who say they were emotionally dead before they attempted suicide. They had been suffering from boredom and apathy. This quality of deadness also is found in normal groups used as controls in both countries.

Swedish reserve, Dr. Hendin noted, goes deeper than the Swedes themselves know. They have angry dreams and hostile thoughts that they cannot express openly. In Western cultures, for instance, men don't normally cry, but depressed men who are suicidal will. But not Swedish suicidal men. The reserve carries through to the very edge of suicide itself!

The ideal that has been set for Swedish children is to be first in your class, top man on the totem pole. The result is often a very independent child who seems very manly even when he is young. As an adult he becomes rigid with himself and success-seeking. When he is confronted with worldly failure, he collapses. Swedish suicide might be called performance suicide.

In Denmark, on the other hand, children are not weaned from dependency on their parents. The classical Danish suicide is for reasons of dependency, often occuring in the period of mourning for the death of a loved one or after a divorce. A child psychiatrist in Copenhagen demonstrated to Dr. Hendin that a common form of discipline is not to punish the child but to point out how much his behavior has hurt

"I'll kill myself," a Dane might say to an army officer. "Go ahead, but don't mess up the barracks," would be the answer in this country.

Mama. He soon becomes skilled at using the same device himself in later life. A Danish army psychiatrist, for instance, reported to Dr. Hendin that a typical technique of a soldier wanting to get out of the army was to threaten to commit suicide, warning his superior officers that his death would be on the officers' conscience. Dr. Hendin said the Danes doubted him when he said that in the United States such threats would be meaningless. "You wanna do it?" a U.S. sergeant would say, "Go ahead, but don't mess up the barracks."

Dr. Hendin's national studies also challenged a view long held by sociologists that the international incidence of suicide follows economic lines. Emil Durkheim, in his classic study, *Le Suicide,* published in France in 1897, made the point, which has been maintained ever since, that the greater the income the greater the likelihood of suicide. But Dr. Hendin finds that the rate of suicide is more likely to follow the national trend than income.

In his 1897 study, Durkheim, a French sociologist, recorded many points which statisticians still affirm. He found the suicide rate higher in cities than in rural areas; for the single, the widowed and the divorced, than for the married; for the old than for the young; for whites than for Negroes. He maintained, too, that more women attempt suicide but that men make the more serious suicide efforts.

In 1933, came the second important statistical study of suicide, Louis Dublen's book entitled, *To Be or Not to Be,* which became the point of reference for all subsequent studies. The major psychiatric contributions began with Freud in *Civilization and Its Discontents* and proceeded with Karl Menninger in the nineteen thirties, notably in *Man Against Himself.*

Dr. Hendin contends that the greatest gain in helping to stop suicides will come through the efforts of sociologists, statisticians and psychologists working together. "We haven't the chance to do social engineering," he says, "nor have we the right, for we don't know what evils would come into existence. Each social system has its own price to pay." But psychiatrists do get a chance to help stop the suicide death toll. "People who kill themselves often go to physicians first in the hope that someone will recognize the extreme urgency of their despair," Dr. Hendin states. He also confirms the statement of Dr. Ronald S. Mintz, Assistant Professor of Psychiatry in the University of California, who says that 100 percent of those who attempt suicide and are saved, are glad they survived.

But this does not mean that these

same persons will not attempt suicide in the future, for statistics show that they are the group most likely to try. The fine line between being fed up with it all and acting to end it, as Dr. Lawrence S. Kubie of the Sheppard and Enoch Pratt Hospital, Towson, Md., points out, is the least explored and understood area.

8 reasons for suicide

Dr. Kubie lists the following eight reasons for suicide found in his observation of suicidal patients who lived beyond their attempt to die:

1. The expression of deliberate rage, arising out of an unconscious need for vengeance and growing out of a concealed fantasy of living on to enjoy the suffering that had been caused.

2. The expiation of deeply rooted feelings of guilt through self-punishment.

3. To propitiate and thus avoid punishment.

4. To avert the possibility of yielding to forbidden impulses.

5. A fresh start. This was best explained by one of his patients who said, "I wanted to go right back to the very edge of obliteration, but not over the edge; then I could start anew."

6. To lose or switch identity. This is most often a purpose concealed from its possessor, to change, for example, from a woman to a man.

7. Another hidden need, this time to obliterate a congenital defect by growing up all over again without it. In one patient this might be a disfiguring facial birthmark, in another a deformed arm.

8. The fantasy of reunion after death with a deceased loved one and of living together in perpetuity.

The reasons for each individual, of course, are mixed, and contradictory. Often the conscious motive bears little relationship to the propelling unconscious undercurrents.

There is the prevailing notion that those who threaten suicide do not actually do it. The truth, however, is as Theodore L. Dorpat, M.D. and John W. Boswell, M.D., of the Department of Psychiatry of the University of Washington, reveal in a study on suicidal intent. They discovered that the majority of those who made serious suicide attempts, as well as those who had actually killed themselves, had repeatedly communicated their suicidal intentions to a number of persons. Those who do not put their suicidal threats into action are likely to belong to the category who make only a gesture.

There are also the ambivalent suicides who try to provide the means for their rescue, yet partly are prepared to die. Over half of the persons in this classification whom Dr. Dorpat studied took sleeping pills and were aware that the pills might not kill them.

The serious suicide effort, according to Dr. Dorpat, often takes place after careful planning. Many make definite plans to settle their financial affairs, to arrange their belongings, and even their burials.

What topless suits really mean

Dr. Cornelia B. Wilbur, president of the National Association of Private Psychiatric Hospitals, was asked recently to comment on the topless bathing suit.

"It is too early to tell whether the interest in the topless bathing suit is a signal of mass neurosis or of a healthier society," she said. "Although the California designers of the suit claim to have created it as a gag, surely their purpose, as well as that of the purchaser, is of interest.

"Why did they include suspender-like straps? To hide behind or, like the fireman's red suspenders, to keep one's pants up? The straps rule out the claim for freedom of action in swimming and are a frame for eroticism. Healthier nudity would have been complete nakedness from the waist up.

"Wearing the suit can be either sheer exhibitionism or a rebellion against puritanical standards. A more significant freedom than escape from the top of a bathing suit may be at stake. The woman who wears it may be saying there should be more freedom for women, although she must admit that women are relatively free.

"As a society, wearers as well as judges, both at the beach and in court, may be ready to step out of our puritanical tradition to an acceptance of the human body, or even a glorification of the body.

"A Freudian interpretation might be that to display one's breasts or to draw attention to them has an anti-castration meaning. Women are saying, 'See? I have breasts. I am every inch a woman.'

"Buying a topless suit might be only an eruption of infantilism. Children of a certain age take great pleasure in taking off their clothes and running around naked.

"It also might be a reaction against intensive shame. Women have had to hide their breasts for so many years, they might be ready to say, 'All the world knows we have breasts and we are now proving to ourselves and others that breasts are beautiful.' However, even the woman who decides to wear a topless suit to be seductive should examine her motives. She may be trying to attract men only because she needs attention or, for that matter, because she is hostile to men. She also may be showing her hatred of her fellow women.

"In all events, the topless suit shows that you can't kid this society. There are always people who rush to buy your gag item, and psychiatrists who are willing to consider it seriously."

Mobility and versatility will be the two key features of the Army we'll have in the near future.

The 1970 Army

The soldier of World War II or even the Korean War will hardly be able to recognize the sophisticated equipment of the Army of tomorrow.

by James H. Winchester

IN TODAY'S changing technological world the Army has weapons in existence—and others far advanced in research and development—which the GI of 1941-45 scarcely dreamed possible.

"The contrast between today's equipment, as advanced as it is, and that which we will have in the 1970s will be greater than the changes achieved between World Wars I and II," predicts Lieutenant General William W. Dick, Jr., Chief of Army Research and Development.

One of the major advances, says General Dick, will be the development of the RADA—Random Access Discrete Address—communications system. This is a revolutionary new system—expected to be in the hands of field troops within six years. As described recently by the official U.S. Army Information Digest:

"It will operate somewhat like a dial telephone system. A number of radio transmitters and receivers may operate simultaneously on the same broad frequency band; but a set which is transmitting communicates at any one time only with the desired receiver by means of coded signals. All other receivers get the signal but reject it since it isn't the correct code. These codes can be changed by a simple dial-like procedure."

By 1970 the Army expects to sharply increase its long-range communications through the use of

By 1970, a field army will be capable of applying almost any level of force required anywhere in the world. This rocket-firing copter is just a starter.

space satellites. Mobile radio stations, operating through communications satellites, will travel with Army task forces, allowing command and control of troops anywhere in the world.

Use of nuclear power

An urgent requirement is that more power sources be carried with units into battle. Weight and shielding problems preclude the use of nuclear power for all but very large vehicles at least in the near future. The Army, however, is planning indirect use of nuclear power through its conversion by mobile reactors to store electrical power.

Another way the Army expects to reduce its fuel supply is through the use of small gas-cooled nuclear reactors. According to the Corps of Engineers, in combat operations, 12 percent of the Army's petroleum requirements originates with semi-mobile installations—command and communication centers, field hospitals, depots, radar and weapons systems, and the like. These units of a typical field army require two million kilowatt hours of electricity every day. Already being field tested, to meet these demands, is the ML-1, a 300-500 KW trailer-mounted reactor facility. It will operate for 10,000 hours on a single loading of nuclear fuel, remaining totally independent of fuel supply for more than a year. It can be transported on standard military semi-trailers.

Presently under construction for the Army is a new barge-mounted nuclear reactor plant. The 10,000 KW plant is being installed in the

hull of a modified World War II Liberty ship. The floating plant is designed to operate at dockside or at anchor, supplying power to shore units through overhead or submarine cables.

As for weapons, a whole new family of ground-to-air and ground-to-ground missiles will be in the hands of U.S. troops by 1970. The Pershing, a mobile, solid propellant missile, is already replacing the first generation Redstone. The replacement for Corporal, the Army's original general support missile, is the Sergeant. Then there is the Lance, which will be the Division-level support weapon, to replace today's Honest John and Lacrosse systems.

"The principal weapon for the individual soldier in 1970 will in all probability still be the M-14 rifle," says General Dick. "However, the possibility does exist that we may be able to add a special purpose weapon for selected individuals."

GI's uniforms will probably change little in appearance. By 1970, however, the Army does expect the uniform to be an integrated ensemble which, by addition or subtraction of components, will allow it to be used in any climate. In addition, protective measures against agents which might be used in chemical or germ warfare, will be incorporated into the field uniform, along with the water repellant substance Quarpel.

Another improvement will be a molded sole combat boot. It will look like the present boot, but with a new, remarkably tough sole molded to the upper part. The sole will last as long as the upper part. Also by 1970, the Army expects to have ready a new combat armortype vest which will be considerably lighter than current versions, but providing superior protection.

Also in prospect for America's 1970 foot soldiers is a device to permit reasonably good night vision. Using image intensifications, rather than today's infrared, this device—probably in the form of goggles—will magnify existing light to many thousands of times.

Right around the corner

Here is what the Army's Research and Development Command has to report on other developments coming up soon:

"There is a good possibility that by 1970 our present 81 mm mortar will be replaced by the British-developed K-mortar of the same caliber. This mortar will be 25 percent lighter than our present model, yet its range will be that much greater. Similarly, the M30 4.2 inch heavy mortar may be replaced by a 107 mm model whose weight will be half that of the M30, yet its range will far exceed that of the present 4.2.

"The new M60 machine gun is a good weapon, and there are no plans at this time to replace it by 1970. However, we are working on a new rapid fire weapon system to replace the current .50 caliber machine gun.

"Anti-tank weapons are receiving a great deal of effort. By 1970 we

A whole new generation of ground-to-air missiles will be in the hands of U.S. troops by 1970. They will replace first-generation missiles now in use.

should have one or possibly two heavy systems which will have command-guidance, automatic optical tracking fire control. In addition, by 1970 the existing light and medium anti-tank assault weapons should be replaced with a single man-portable weapon.

"Under development are new anti-tank mines with versatile fuses capable of defeating all tanks, whether moving on land or crossing inland waterways, a scatterable anti-personnel mine, and an air-emplaceable mine. We also expect to have new means of arming, disarming, or temporarily inactivating mines."

The picture at this time for artillery appears to be that the recently standardized, armored, self-propelled 105mm and 155mm howitzers T195 and T196, and the M110 8-inch howitzer, and the M107 175mm gun will still be in the "useful life" category in 1970.

To provide forward area protection against low level aircraft the Army is developing Redeye, a fin-stabilized missile operated by an infrared guidance system. Launcher plus missile weigh only 20 pounds and it can be carried and fired by one man.

In addition, Mauler is expected to be ready prior to 1970. This will be a compact missile system mounted on a single full-tracked armored vehicle to provide defense against manned aircraft, drones, and tactical ballistic missiles.

Another weapon system now receiving major emphasis is the chem-

ical and biological incapacitating weapons and the defensive means against such weapons. The unique capabilities of chemical and biological systems to incapacitate without killing has obvious applications where enemy forces are mixed with friendly populations.

By 1970 the U.S. expects to have a family of incapacitating systems, capable of providing a commander with a choice of desired effects. In addition, the Army expects to have rapid detection and warning systems for chemical attack which will be fast enough to permit use of physical protective devices in the field. And, by 1970, prophylaxis and therapy for most known chemical and biological agents should be perfected.

New combat tank

The Army is currently engaged in component research and development to produce a radically new main battle tank by 1970. While its silhouette will probably instantly identify it as a combat vehicle or tank, its mobility will be one-third greater than the M60 tank; its weight will be decreased by one-third through use of new materials; and its main armament, a missile system, will provide a probability-of-hit factor three times that of today's tank.

By 1970 the Army will have a new wheeled vehicle based on the Gamma Goat principle. It will be a jointed—the technical term is "articulated"—six-wheel vehicle with a ton and a quarter capacity. Tests of the articulated Gamma Goat have been truly amazing—it is perhaps the most mobile wheeled vehicle in the world today.

"But by real hope," says General Dick, "is that we can utilize the middle ground, or rather middle space, through the development of true nap-of-earth vehicles. These craft need not move at great speeds, nor at greater heights than just off the ground—for example tree-top level—when such movement is necessary to continue in the face of an obstacle. I do not know what form these vehicles will take, whether they will be both a ground and nap-of-the-earth vehicle or simply the latter. Nor do I know what precise system will be used to propel them. However, I hope that we can attain a breakthrough which will allow us to have by 1970 limited numbers of experimental vehicles of this type. They could well provide the answer to many of our mobility problems."

With these new developments and plans, the U.S. Army's ground force in 1970 will be potentially much bolder and decisive than in the past, with impressively increased mobility.

* * * *

AUSTRALIA's Great Barrier Reef is the world's most extensive hunting ground for the coral fancier, the shell collector, the underwater explorer and the marine biologist. It is 1,250 miles long and 150 miles at its widest. It has the widest variety of marine life found anywhere, says the National Geographic Society.

Chemistry in the raw

by John and Molly Daugherty

NEARLY everything serves as raw material in the chemical industry. The sources are organic and inorganic. They seem infinite and come from the land and the sea and the air.

What do you know about the chemical products you use?

1. The major source of raw materials for producing organic chemicals is
   a. Animal matter
   b. Fossil fuels
   c. Vegetable matter

2. When coke is made from coal, various by-products such as gases, light oils, coal tar, and some ammonia compounds are given off. From which of the following is aspirin made?
   a. Gases
   b. Coal tar
   c. Light oils

3. As chemical products are manufactured more efficiently, costs are often dramatically reduced. Which one of the following was reduced from $242 a gram to $1.90 a gram (1/454th of a pound) within a ten-year period?
   a. Cortisone
   b. Penicillin
   c. Synthetic Vitamin A

4. Which one of these reactive metals has uses in the structural parts of jet airliners?
   a. Boron
   b. Potassium
   c. Titanium

5. Natural gas is an important raw material base for the production of many chemical products. Which of the following is produced using natural gas almost entirely as its base?
   a. Ammonia
   b. Synthetic rubber
   c. Formaldehyde

6. Most of our raw inorganic materials come from domestic sources, but there are exceptions. From which countries does about two-thirds of our supply of bauxite (aluminum ore) come?
   a. Canada and Mexico
   b. Peru and Chile
   c. Surinam and British Guiana

7. In 1925 the output of chemicals produced from petroleum and natural gas was about 75 tons. Some 33 years later, what would you guess the approximate output of chemicals from these two raw materials to be?
   a. 7,000,000 tons
   b. 14,000,000 tons
   c. 21,000,000 tons

8. Reactive metals require special chemical techniques to produce in pure form from their respective ores. Which one of the following reactive metals, in the form of its compounds, is used as a pigment in bright red to orange paints and also in some printing inks?
   a. Lithium
   b. Molybdenum
   c. Beryllium

9. Of the more common acids made from various raw materials, which one of the following acids is most widely used in the chemical industry?
   a. Sulfuric acid
   b. Nitric acid
   c. Hydrochloric acid

10. Which one of the following chemicals is used in gravel-based roads as a stabilizer?
    a. Sodium chloride (salt)
    b. Calcium chloride
    c. Ammonium chloride

Answers:

1 - b The fossil fuels: coal, petroleum, and natural gas. Animal and vegetable matter is also the source of many organic chemicals. An estimated 800,000 organic chemicals are known, and the list is constantly growing.

2 - b Coal tar. Coal tar is the source of thousands of compounds. Aspirin is one of them. Some other products obtained include dyes, creosote, pitch, napthalene, and gasoline additives.

3 - a Cortisone. From 1949 to 1959, the wholesale price of cortisone fell 8/1,000ths of its former price of $242 a gram. The decrease in the price of penicillin in a fifteen-year period is even more startling. In 1944 the wholesale price for a million units was $89. In 1959 the price was 3¢ for a million units.

4 - c Titanium. In 1937 titanium was listed as a reactive metal with no important uses. By 1949 only 25 tons of the sponge metal were produced, but in 1959 production reached over 17,000 tons. Titanium is a tough lightweight metal with excellent resistance to heat and corrosion. The metal is used in aircraft, jet engines, missiles and rockets, and also in surgical instruments.

5 - c Formaldehyde. In 1959 all of our formaldehyde came from natural

gas. Formaldehyde is best known as a preservative in the biological sciences, but it has various other uses. Approximately 80 percent of ammonia production also comes from natural gas with the aid of hydrogen to fix atmospheric nitrogen. Natural gas is widely used in making synthetic rubber, too.

6 - c Surinam (Dutch Guiana) and British Guiana supplied 64 percent of our needs as far back as 1957. Our need for chrome ore is met by imports from the Union of South Africa. In 1957 Brazil and India supplied 98 percent of our manganese, essential in steel manufacturing.

7 - c 21,000,000 tons and over. More than 2500 different chemicals are derived from petroleum and natural gas. These chemicals represent more than half of the dollar value of all U.S. chemicals. The end-products for more than half of these chemicals include such things as fibers, fertilizers, plastics, and synthetic rubber.

8 - b Molybdenum. Millions of pounds of some of its compounds are used as pigments. Molybdenum has many other uses, such as an alloying agent with other metals. Some of its compounds are used in lubricants. Certain derivatives serve as catalysts in making high-octane gasoline.

9 - a Sulfuric acid. About 80 percent of our sulfur output is used to produce sulfuric acid. Production and use of sulfuric acid—over 16,000,000 tons—is about 20 times as great as that of hydrochloric acid and at least 6 times as great as that of nitric acid. Sulfuric acid is used in countless chemical manufacturing processes, which include as end-products fertilizers, petroleum refining, paint pigments, textiles, and steel processing.

10 - b Calcium chloride. When it is used as a stabilizer in gravel-base roads, the savings in replacement costs of the road may be as much as $300 a mile. Another example of savings by using the products of chemistry is in plastic coatings for wire and cable.

Score yourself:

8 - 10 right—Your raw score is rare!
4 - 7 right—Rarely does one know more than you about raw materials unless he's a chemist.
0 - 3 right—You're apparently a raw recruit in this field.

ENFORCED health? Studies of what happened to patients when the doctors were out on strike in Canada and Belgium showed that less people died during the strike in both countries than in normal periods. Also, the Saskatchewan, Canada, hospital load was abnormally low at that time, according to a spokesman for the doctors there.

Dr. Joseph Farber, vice-president of the Belgian Medical Assn., attributed the lower death rate in Belgium to improved emergency services. Instead of accident victims being treated by interns in the usual manner, they were treated by Belgium's best doctors during the strike. First-rate doctors even rode ambulances, he said.

How we're cracking the code of life

Molecular biologists now know more about the life process than would have been dreamed possible ten years ago. One of the leaders of this biological revolution is Nobel Prize winner Dr. Severo Ochoa, who here explains our new understanding of life in an interview with correspondent Charles Collingwood. It is adapted from "Tomorrow Was Yesterday," a TV program in the CBS News "Chronicle" series.

COLLINGWOOD: It was only a generation ago that Darwin's theory of evolution collided noisily with an ancient religious fundamentalism in the notorious Scopes monkey trial in Tennessee. Essentially, Darwin's theory brought the life sciences into conflict with one of the widest held basic beliefs of man. The advances in biology and biochemistry in recent years have brought evermore startling knowledge to light as the result of man's never-ending effort to discover the chemical origin of life, and how life reproduces itself, be it microorganisms, plants, the fish of the sea, the fowl of the air, or the men and animals of the earthbound kingdom. Three billion years ago the earth existed without life on it. We know it had only the waters of the seas, the chemicals, the gases, the electrical storms. A quiet question was raised: if we could duplicate those same conditions of three billion years ago, could we duplicate as well the rise of life?

A few years ago at the University of Chicago, a glass dome was built. In it, simulated electrical storms were created. At its bottom, a half-inch of salt water. Above it, ordinary ammonia, carbon dioxide and methane gas, the atmosphere of earth three billion years ago. After

The coils of the DNA molecules contain an immense amount of information, yet are so tiny you could have a million of them in a molecule.

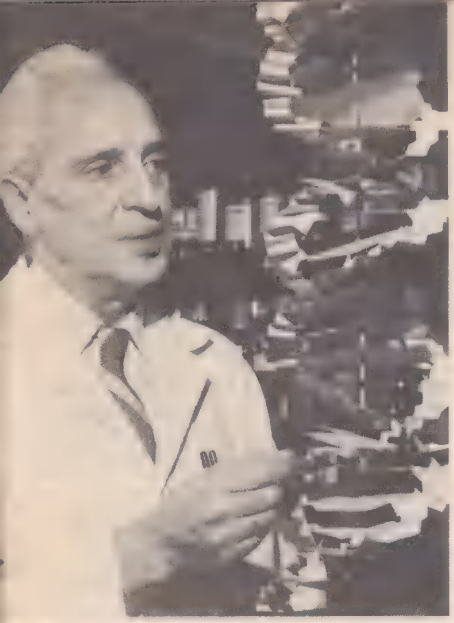
a week of lightning, the water in the dome turned pink. What had been born in this simulated primeval atmosphere were amino acids, the building blocks of protein, the stuff of life. Science knows that from amino acids came that highly complex little unit, the living cell, and from the cell all the more complicated living creatures. The unique characteristic of life is that it recreates itself after its own pattern. Plants create like plants. Mammals, like mammals. Not all men resemble their brothers in detail, of course — some have blond hair, some brown, some black, their features differ in minor detail — but all are members of Homo Sapiens and are as closely related genetically as the peas in a pod. How this biochemical recreation of staggeringly intricate structures was accomplished appeared to lie beyond the possibility of comprehension a mere 10 years ago. Now the secret has been discovered. Dr. Severo Ochoa, Professor of Biochemistry at New York University, shared a Nobel Prize for his work in this triumph of molecular biology.

Dr. Ochoa, am I right in supposing that the chemical mechanism of heredity couldn't even have been predicted a generation ago?

OCHOA: That is correct. It could not have been predicted without our present knowledge of the chemistry of the compounds of heredity, DNA, RNA and proteins and of their mode of formation in the body. But now we know — and this was found sooner than we expected — that the fundamental process of life can be spelled out with merely four chemical symbols, which combine in groups of three to make what we might call 64 letters. And this describes not only the mechanisms of life, but also of heredity — the continuation of life.

COLLINGWOOD: Well, any of us who have studied any biology at all have heard of the gene, the abstract concept introduced by Gregor Mendel to account for inherited characteristics, like having blue eyes or the size of a geranium. Does such a thing as a gene really exist, or is it just a product of our imagination?

OCHOA: Well, we have long known that genes really exist. They are located in the nucleus of the cell, inside tiny thread-like bodies called chromosomes. Scientists have observed chromosomes in the act of splitting, when the cells reproduce themselves by dividing. They have also found, in the chromosomes, molecules of a substance we call DNA. The molecules of DNA are shaped like a coiled ladder. We



Dr. Ochoa with DNA molecule model.

call this a double helix. They are present in all cells of all living beings whether they be animals, fish, plants, microbes or man, and they direct the activities of the cell and how the cell shall function. The molecules of DNA also have the capacity to make exact copies of themselves, and in this way they are responsible for the continuity of life through generations.

COLLINGWOOD: Well, does the DNA contain all the information that's necessary to make an organism?

OCHOA: Of course, you must realize that the DNA molecules are extremely tiny, and their coils are so tight that you could have millions of them in a molecule. Nevertheless, they contain an immense amount of information. One ten-trillionth of an ounce of DNA from a father, in combination with one ten-trillionth of an ounce of DNA through the mother, contains all the specifications to produce a new human being. Now, in the case of specific characteristics, such as blue eyes or red blossoms in roses, sections of the molecules contain the necessary specification, and these actions are called genes.

COLLINGWOOD: How can anything so small contain so much information?

OCHOA: This is contained and transmitted by means of the code. If you think of the Morse Code, you realize that it has enough information to describe the more complex things or very less things by means of just two symbols, a dot and a dash. Now DNA has four symbols, only they are no symbols, they are chemical substances, Adenine, Guanine, Thymine and Cytosine, here indicated with the first letters of their names. These substances are aligned along the course of the DNA molecule in a unique order, and it is this order that determines how cells shall function. In so doing, the four characters are arranged in groups of three to form triplets. You can actually think of this genetic code as a foreseeable code which uses three characters at a time. And each of these triplets, for example, AAA, AAD, CTC, which are in a way equivalent to the combinations of dots and dashes in the Morse Code, specifies one of the 20 amino acids, the building blocks.

DNA can make a mistake when it reproduces. If it does, the result is a mutation. These mistakes of nature have made evolution possible.

Now, proteins have hundreds or even thousands of amino acids and one protein differs from another in the order in which the amino acids are assembled. So you can easily see that there's lots of room for variety.

COLLINGWOOD: What happens if you change the symbols in the DNA code?

OCHOA: If you change the symbols and therefore the order of the amino acids in the protein which is produced from this change blueprint, you will either change the organism or something in the organism. And the change need not be great. For example, if one changes one letter in the word "cat," you can get "rat." So a little change in the DNA can produce a big change in the creature that results.

COLLINGWOOD: Now, does that mean that the DNA can't make a mistake in the ordering of its parts when it reproduces itself?

OCHOA: It can, it does, but rarely. If a mistake is made then you get the changed organism—or in other words, a mutation. If the mistake proves to be advantageous the organism thrives, and the mistake is preserved and handed down to further generations. Thus we have evolution.

COLLINGWOOD: Now you said that the DNA controls the ordering of the cell. How does that work?

OCHOA: Well, the DNA is in the nucleus of the cell, and outside are little factories called ribosomes, which are the sites where proteins are manufactured. DNA directs this manufacture by means of two assistant molecules, which are in fact copies of the DNA. One of these is called messenger RNA. It picks up the blueprint from the DNA and takes it to the factory for the assembly of building. The other kind of foreign aid, also created by DNA, called transfer RNA, selects amino acids, which are plentiful in the cell, and takes them to the factory for manufacture or building. This protein may be needed to make blood, bone, hair, stem, blossom, or whatever the DNA blueprint dictates that it shall be.

In reality we have a thorough assembly line mechanism whereby the ribosomes, represented by this, glides along the molecular messenger RNA, and as it does so the protein is made and eventually released as is the ribosome.

COLLINGWOOD: Now what progress

has been made in understanding this code, in knowing what arrangements, what combinations will make what protein, what organ, what creature?

OCHOA: Up until two years ago, we had no idea of what arrangement meant what, but now we know the letters of the genetic code which select each of the amino acids. What we do not yet know, at least in all cases, is the order of the symbols within these letters.

COLLINGWOOD: And, of course, we don't know yet how it all began, do we?

OCHOA: That is quite correct.

COLLINGWOOD: The DNA molecule has been called the atom of life. When we have harnessed it, the harnessing of the uranium atom will seem in comparison a kind of adolescence.

When man has mastered the genetic code he'll hold a vast power in his hands; even a power over the nature of coming generations of his own kind.

"Look at it this way, Professor, we're helping to preserve him for science."

INVENTOR OF THE MONTH

How to steer in space

MacDonald Sill's catalyst bed is contained inside the rocket motor he is holding.

For 26 years, in what is now called the aerospace industry, MacDonald Sill has been improving the things that men have flown in—from slow prewar airplanes to space capsules. His latest contribution is a little device that has enabled the Mercury astronauts to twist their vehicles around in space.

The invention is a tiny stack of nickel screens, plated with gold and silver. The catalyst bed that it forms is the heart of the little rocket motors used to stabilize and maneuver spacecraft. Patent 3,135,703 was recently granted for it.

The catalyst decomposes hydrogen peroxide into oxygen and superheated steam. As they jet from the rocket nozzle, the two gases provide the thrust needed to regulate pitch, roll and yaw and to rotate a vehicle for reentry.

According to Bell Aerosystems Company of Buffalo, N.Y., the invention has been used, either automatically or manually, in every U.S. manned space flight. Sill, *Science Digest* Inventor of the Month, is director of engineering administration for Bell's Aerospace/Rockets Division.

The nickel wire mesh through which the hydrogen peroxide passes is plated, the patent explains, with about 99 percent silver and 1 percent gold, "the plating being deposited thereon in rugose surface form." A baffled reader of the patent will find *rugose* to be a botanical term meaning "full of wrinkles."

The Bell company, which is a division of Bell Aerospace Corporation, a subsidiary of Textron, Inc., supplies the patented catalyst bed to other propulsion manufacturers besides using it in its own reaction control devices. One such device is the Bell rocket belt designed to enable a space man to move about.

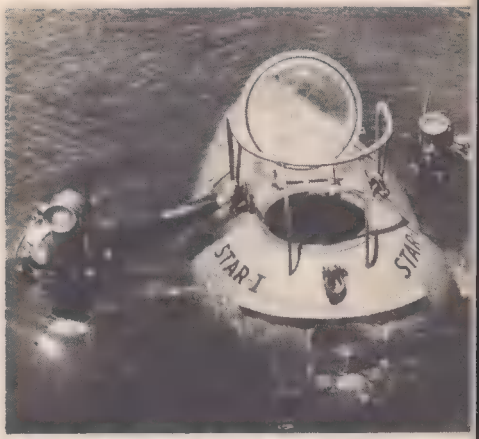
Eleven years ago Bell started work with space controls when it developed wing tip rockets for the X-1B research plane. Ordinary aerodynamic controls did not function in very thin atmosphere. According to the company, this application prompted the first use of hydrogen peroxide control systems. Similar equipment is aboard the X-15, which has operated at altitudes beyond 50 miles.

The Centaur, the country's first hydrogen-powered space vehicle, also carries a Bell reaction control system. By the time MacDonald Sill's patent was issued, the National Aeronautics and Space Administration had successfully launched one and planned two more flights for 1964.

—Stacy V. Jones

INVENTIONS PATENTS PROCESSES

The world's first fuel-cell sub



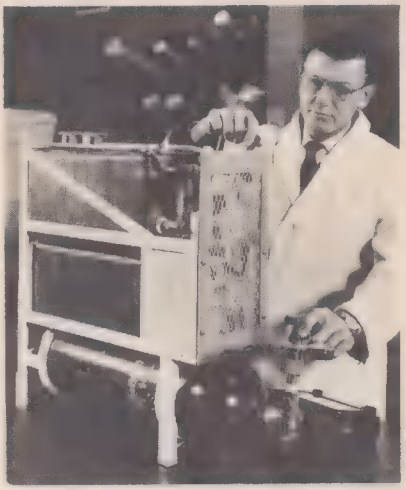
Star I is a 9-foot sub developed by General Dynamics to test components and systems.

A TEARDROP-shaped submarine only nine feet long is the first submarine in the world powered by a fuel cell. The *Star I*, as the vessel is named, recently had its first fuel cell test run at Groton, Conn.

Fuel cells are devices that convert the energy of chemical fuel directly into electricity without moving parts. Allis-Chalmers, Milwaukee, Wis., developed the cell for *Star I*. It is a 36-volt fuel-cell system that uses hydrazine as fuel and oxygen. Through chemical reaction, the system produces 750 watts of electricity.

The fuel tank and system occupy a 22-inch-long space behind the *Star's* spherical pressure hull. It delivers enough power to propel the *Star's* two electric drive motors, which are mounted outside the hull, and to operate the sub's communications, navigation, life support and lighting equipment.

The *Star* is the first in a series of small underwater craft developed by General Dynamics/Electric Boat



In recent test, sub was powered by this 22-inch fuel cell which fits behind hull.

Division of Groton to be used to evaluate components and systems for future underwater craft. Its operator sits in a plastic bubble-topped, steel pressure hull. The little craft can be "spun on a dime,"

and it can hover like a helicopter when being used for observation. It can go to a depth of 200 feet and has a speed of slightly under one knot.

The vessel was adapted to fuel cell power to extend its capabilities. Allis-Chalmers spokesmen say that the fuel cell more than doubles the *Star's* endurance.

Swivel-base color TV

An Automatic Color Purifier is an important feature of RCA's Driscoll, one of the company's new line of color TVs. The Driscoll has a swivel base that allows the set to be turned to face anywhere in the room for viewing from different angles.

In the past, color sets could not be moved to other locations without losing color quality. The Color Purifier cancels the magnetism that might cause distortion when the set is swiveled, or even moved to another location.

RCA's swivel-based TV points up new moveability of two of the company's color sets.

The Driscoll is contemporary in styling and comes in all-wood cabinets in autumn mahogany or natural walnut veneers and in selected hardwoods.

The Color Purifier is also a feature of the Whitman, a color TV console. The set has concealed casters so that it can be conveniently moved about in the home.

Pave-as-you-go

An 11-foot-wide aluminum roadway which can be unrolled over difficult terrain at a rate of 10 miles an hour, and can be re-used later in another area, has been developed in England and is available for export to this country.

Trackway, as the product is called, was developed by the Military Engineering Experiments Establishment at Christchurch, Hampshire, in conjunction with the British Aluminum Co., Ltd. Its manufacturer is Saro Ltd., Beaumaris, Anglesey, North Wales, Great Britain.

The road will bear vehicles of 20 or more tons. Although originally designed for military use, it is expected to be useful in construction, lumbering, and mining. It consists of light alloy planks interlocked with articulated joints which allow it to be carried, in a roll, on a truck fitted with special track-laying equipment. A three-ton truck can carry 165 feet of Trackway.

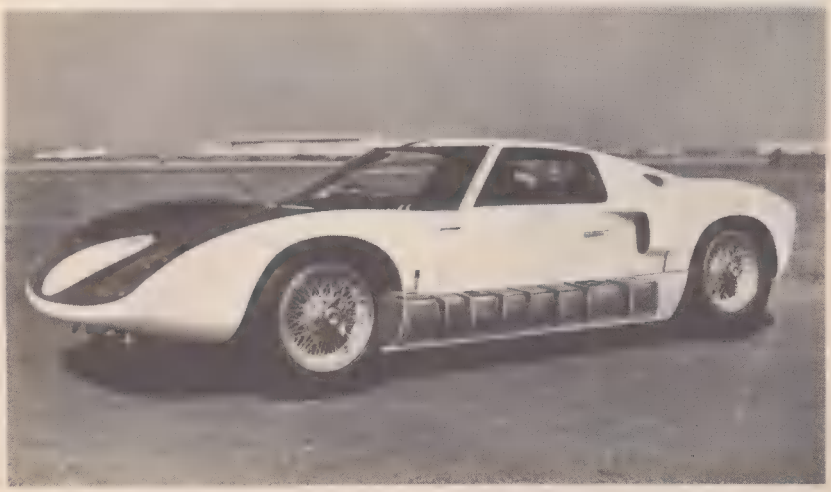
A roll of the material is carried with its axis parallel to the direction of the vehicle. The roll is swung through 90 degrees on a turntable and the dispensing equipment and the Trackway is inserted under the front wheels of the truck. As the vehicle moves forward, the Trackway unrolls and is laid out on the ground under the truck. The vehicle is guided by a distance-rod attachment, or a human guide can take over when safety or great precision are critical.

Rubber fuel tanks for racer

A new kind of fuel tank for racing cars has been produced by Goodyear's Aviation Products Division and is making its appearance on the new GT competition car introduced by Ford as a test vehicle.

The tanks are rubber and nylon and are made with the company's spray urethane technique to fit areas of the car not normally used to hold fuel. Rubber is used because of its inherent shock resistance and the fact that a flexible, bladder-type tank can easily be installed or removed through a small opening without disturbing any body panels. Goodyear has been producing such tanks for aircraft for some time, but this is the first instance of their use on an automobile.

The Ford Motor Company's Dearborn, Mich., headquarters produced the design concept of the new GT. The vehicle is only 40.5 inches high and has an overall length of 159 inches on a 95-inch wheelbase. It is powered by a Ford Indianapolis racing engine positioned behind the driver, but ahead of the rear axle.



Artist's drawing superimposed on photo of racing model shows where rubber gas tanks are fitted inside the body shell of Ford's GT competition car.

The location of the engine and several other design features prevents the mounting of the gas tanks in the usual position behind the rear axle and under the body. This prompted the decision to install tanks in the sides of the car. The solution was to put one tank on each side, mounted inside the body shell, in the space between the front and rear wheel wells above what would be the rocker panel on a conventional auto.

Sportsmen's shoulder guard

A cushioned shoulder covering that makes it easier to carry a pack, or protects a hunter's shoulder from the kick of a rifle, is offered by F. M. Zubiate and Co., Dept. SD, 1426 Stannage Ave., Berkeley 2, Calif.

Zubie Shoulder Covering is made of heavy urethane foam covered with strong cloth. It can be washed in a washing machine.

Shoulder protection offers more comfort for hikers and rifle-carrying hunters.

Doggie deterrent

A small aerosol container filled with a mild eye irritant which can be used by postmen to discourage aggressive dogs is being marketed by a British firm, Walter Gregory & Co., Ltd., Wellington, Somerset, England. One squirt at the attacking dog will affect its eyes for about five minutes, but will leave no aftereffects. .

Man-Made stereo diamonds

You shouldn't ever have to change the needle in General Electric's 1965 stereo phonographs. The company is guaranteeing them for the lifetime of the phonograph.

Diamond needles? Not quite. GE has been making artificial diamonds under the trade name, Man-Made diamonds, since 1957. However, this is the first time the diamonds have been available in a consumer product.

Diamond is the hardest substance known, and GE is apparently sure enough of the quality of its synthetic diamonds to offer an immediate replacement through the mail for any defective needle.

Processing can be controlled to produce diamonds of uniform size, shape and purity.

Don Ollis

An Indian witch woman holds a "headache plant," one folk remedy being studied.

Jungle medicine

For the modern patient, medicine comes out of the bottle or the syringe. For the doctor it comes from the chemist's laboratory.

But things were not always this way. At the turn of the century, 80 percent of all medicines came from roots, barks and leaves, and much of it was "home brew."

With the rise of synthetic medicines, most plant remedies were discarded. Now a small but significant countermovement has begun. This is not to say that grandma's herb tea or the witch woman's potion will cure you better than a doctor's prescription, but science has vindicated at least some of the folklore about plants that heal.

When plants that have some healing powers in their natural state are taken into the laboratory, tested and refined, a truly excellent new medicine may result.

The medical uses of plants in civilized lands seems to have been pretty well exhausted. Botanists have turned to the jungles for new sources of healing plants.

The story of this medical movement is excitingly told in the book *Green Medicine* by Margaret B. Kreig (Rand McNally, Chicago, $5.95). The excitement of Mrs. Kreig's book is not mental. It is the sheer physical excitement of the explorer undergoing unbelievable hardships in strange places to find a rare and exotic tropical plant or discover the secret of a native drug.

What sort of a person goes off into the jungle to hunt for plants? Mrs. Kreig quotes from the field notes of Dr. Richard Evans

Schultes of Harvard. He was going up an Amazon tributary in a 30- by 12-foot barge with 14 other people, including a girl with an advanced case of leprosy, and an assortment of animals plus baggage and a cargo of dried fish.

One moment Dr. Schultes is describing how leaky and dangerous the barge is, and how one wall of his cabin is missing. Then he relates, "I came down with a very high fever. Have rheumatic pains in every limb and back, continuous nausea, some vomiting. . . . Vomiting continuously, very weak, probably mostly from malnutrition—we have had no warm food, only a tin of sardines for supper last night." At the time Schultes was suffering from malaria and beriberi, although he didn't know it.

In the middle of this agony, Schultes tells how the barge ran into a tree along the river's edge and how excited he was because it was a type of tree he had been particularly anxious to collect.

Then he writes, "I have also noticed beautiful coconut trees here, disproving the notion that the palm cannot thrive far from the sea. While the boat is being patched up, I am anxious to do some collecting along the bank. . . . [Next day] Overdoing brought on violent vomiting with blood, am very weak. Will have to leave the intensive work until we come back downstream, when I hope to feel better."

You would think an experience like that would send any self-respecting scientist scurrying back to a quiet laboratory. But not Dr. Schultes. With a devotion that is astounding he spent a grand total of 13 years in the Amazon jungle, broken only by a period of hospitalization in the United States.

To get into the spirit of things, the author herself went on a plant collecting expedition in South America. Her descriptions, particularly of what must be the most hair-raising bus route in the world, are well worth reading.

Not all plant hunters have to be rugged enough to go tramping through the jungle. For example, Dr. Siri von Reis, a former high-fashion model, now spends her days going through the 2,000,000 specimens at the Harvard University Herbarium, looking for data useful in modern medicine.

Although the interest in folk medicine has really just begun, these plant hunters are men in a hurry. Richard Schultes explains why:

"The accelerated divorcement of primitives from dependence upon their plant environment can be illustrated by what happens when aspirin pills are made available along the Amazon. This seems to start an astonishing disintegration of native medical lore. The rapidity of this is frightening. That the aspirin may be more beneficial in some cases than the herbs it supplants is not the point. What should concern us is: How can we salvage this priceless medico-botanical knowledge before it is forever entombed with the culture that gave it birth?"—*D.C.*

Science in the news

Economically desalting sea water is emerging as the world's number 1 scientific and engineering problem. Finding a solution has become the newest area of U.S.-Soviet cooperation. Scientists from both nations are swapping information to see if a joint attack on the water shortage can be worked out. Most promising plan is to use atomic power to run desalting plants. (See A-power Can End the Water Shortage, Aug. '64).

A successful process could have fantastically far-reaching political consequences. Examples: Fresh water is the big bone of contention between California and Arizona, the U.S. and Mexico; lack of water caused the collapse of Khrushchev's pet Virgin Lands plan (all Asiatic Russia is arid); Israel's decision to tap the Jordan River for more water prompted Arab countries to threaten war, but Israel has plenty of brackish water which could be used if desalting ever gets started on a large scale.

A U.N. report points out the emerging nations would be the biggest buyers of desalting equipment when it became available. The report also states the use of today's comparatively expensive desalting methods is now justifiable in some areas. That's how serious the water shortage is.

Science in the news

U.S.-Soviet cooperation in space will also be extended. Representatives from both countries are meeting to discuss possible Russian participation in a global space communications system.

Cooperation in the biological and medical aspects of space will also be widened. Experts in both countries are quietly worried that John Glenn's persistent dizziness after his fall last February might be related to inner ear ailments that have afflicted Astronaut Alan Shepard and Cosmonaut Gherman Titov. Soviet space medicine expert Prof. Vassily V. Parin feels flights lasting more than two weeks could be harmful without some sort of artificial gravity in the ship.

One tidbit brought back by a U.S. space physician who visited Moscow: The Soviets don't plan to send any more women into orbit. Cosmonaut Tereshkova may have captured the public's imagination but officials were not satisfied with her performance. Her pulse rate showed she became too excited.

East-West harmony doesn't tell the whole story: The U.S. launched three satellites with a single rocket. Purpose of the shot was to perfect a means of detecting secret nuclear explosions from space. . . Analysis of recent Soviet missile tests indicate that they have developed an improved ICBM capable of carrying multi-megaton warheads and delivering them accurately at over 6,000 miles. Military men believe such missiles are designed to strike at U.S. missiles buried in hardened concrete and steel silos.

The space program survived an attempt to cut funds for the manned moon trip--but just barely. Budget cutters were drawn from an unusual coalition of Republicans and Democrats, liberals and conservatives. Outlook: increased financial troubles for NASA.

Government programs die more quietly than they are born. Project Pluto, an effort to develop a low-flying, atomic-powered missile, was launched with some enthusiasm. This summer, 10 years and $200 million later, the program was junked in embarrassed secrecy.

Underground atomic explosions for peaceful purposes are about to begin again. Tests deferred when the limited test ban treaty was signed are again being scheduled, the AEC announced. Information obtained will be used in planning large-scale excavating.

Astronomical instruments in space confirmed one theory and upset another: A balloon-mounted telescope found large quantities of water vapor surrounding the huge stars known as red giants. Surprisingly, many astronomers long expected this finding. . . . Astronomers also long expected to find evidence of neutron stars, small extremely dense celestial objects in the center of nebulas. Navy researchers set up an X-ray detector in a rocket to locate the star, thought too small to be visible optically. But they were unable to find one in the Crab Nebula. This may upset a widely held theory of what happens after a supernova explosion.

Science in the news

According to Hoyle, scientist Fred Hoyle that is, the mass of every particle in the universe helps create every other particle. That is part of a new theory of gravity devised by Hoyle and Indian mathematician Jayant V. Narlikar. They call it "a slight extension of Einstein's theory of general relativity." Fellow scientists are still digesting the complex mathematics but doubtless objections will soon be raised to the theory. Even so, it has already been praised as "a parade of splendid mathematics."

Oceanographers have postulated the existence of huge undersea waves. Now this theory has been proved correct through use of a new oceanographic instrument. The waves may reach 100 feet and have been found to occur at least as far down as a mile. They were found by a new type of underwater float developed by Theodore Pochapsky. Cause of such huge waves is still a mystery, however.

The sonic boom problem may be even more serious than anticipated. FAA Administrator Najeeb Halaby announced the unexpected finding that under certain atmospheric conditions the boom created by a supersonic plane can be magnified by the time it hits the ground. The boom problem is one of the most serious obstacles to the use of supersonic airliners. . . .Sonic booms, however, have not slowed Soviet work on a supersonic airliner. Russian aviation officials are confident they will have their liner ready shortly after the British-French Concorde, due in 1971.

The U.S. will be facing a critical shortage of physicists within 10 years, the American Institute of Physics warns. By 1970, government and industry will have a deficit of at least 20,000 physicists. There will also be a scarcity of physics teachers. Worst of all, the Institute says most high-school and college grads have not studied physics.

Pre-election polling took a lot of criticism after the California primary. Now pollsters say they were not as far off as critics charge and that polls are an accurate and scientific way to reflect public opinion. They point out that most forecasts made on the final day before election fell within the accepted statistical range of error, about 2 percent. They say the main usefulness of polls is not to predict elections but to find out what is going through the minds of voters as they make a decision.

Conservationists will try to breed rare Arabian oryxes in the dry climate of Arizona.

QUOTE OF THE MONTH: "Conventional instruments of mental testing, experience had shown, were often fashioned to fit the intellectual and social ways of the middle-class children, with the result that the minority-group children were being excluded from opportunities for training because of the accident of what has come to be called 'cultural deprivation'"--Jerome S. Bruner, President of the American Psychological Association.

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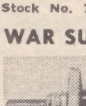

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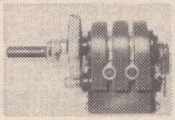

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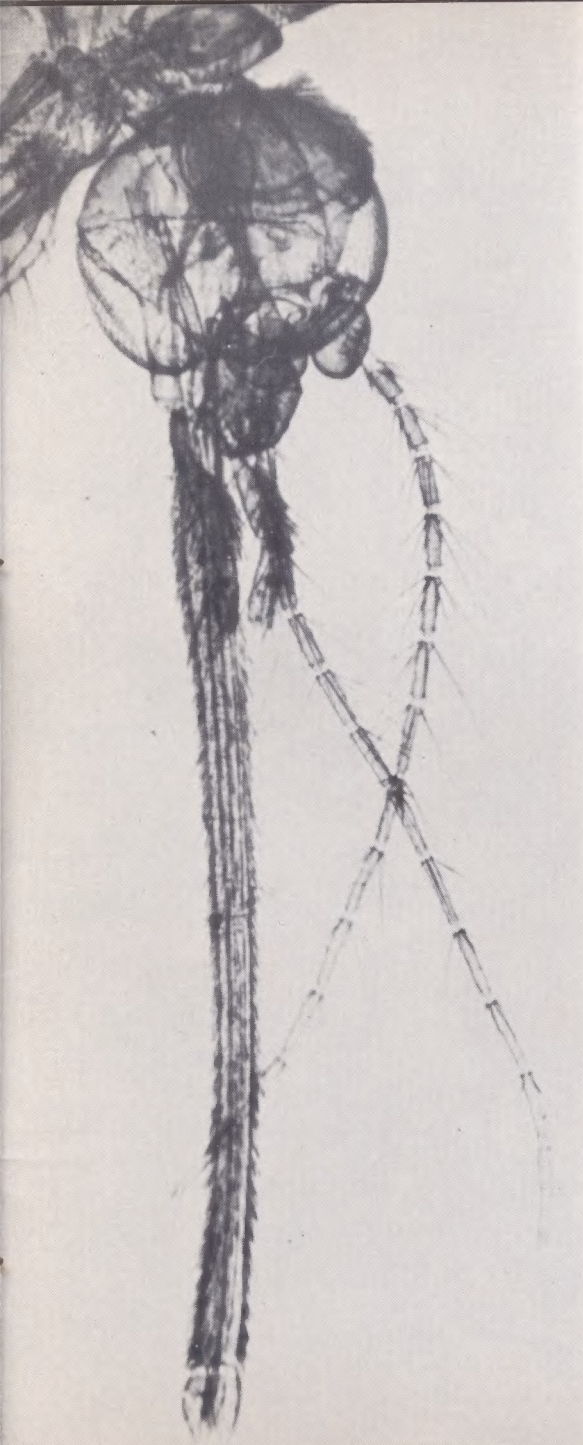
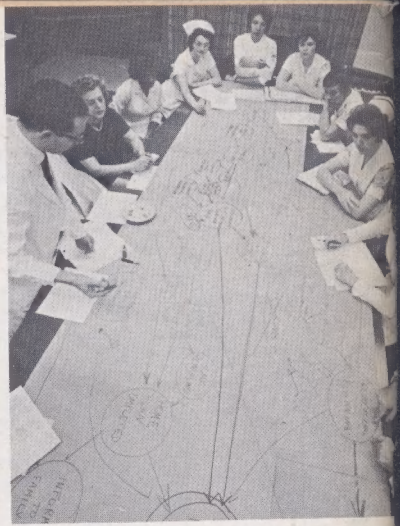


What is it?

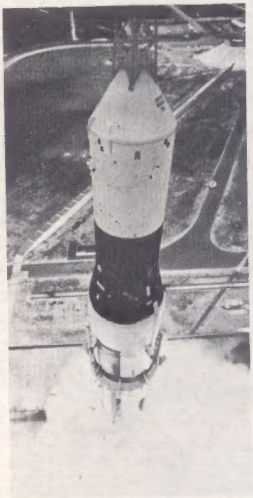
PESKY PROBOSCIS—A sight to perturb summertime picknickers is this unusual magnified view of a mosquito. The long extension from the mosquito's head, and from the heads of its millions of relatives, is the stinger—a cause of concern to governmental officials and a cause of more immediate discomfort to millions of this year's campers, vacationers, and other Americans. The photograph, enlarged 75 times over actual size, was made in Eastman Kodak's photomicrographic laboratory by Lynn Wall. The two other extensions from the mosquito's head are the antennae. This is a female, the sex of mosquito which is noted for its bite.

Also in this issue . . .

Olaf, the New York Aquarium's lovable walrus is in reality only the front man for a growing scientific enterprise. Even clownish Olaf makes his contribution to science. For a behind-the-scenes look at aquarium life, see page 6.

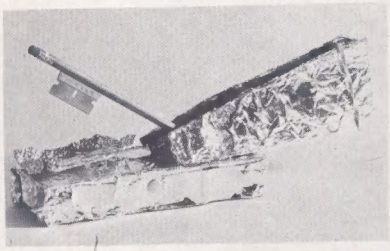


Modern medicine is adopting some of the techniques of industry, including the use of computers to help plan medical programs for patients. Page 19.



When the Apollo/Saturn rocket blasted off in a recent test, an automatic camera was nearby to record on film an unusual view of the most dramatic and spectacular sight of the space age. Pictures of the launching appear on pages 46-47.

A plane crash is one of the most terrifying disasters in today's world. But engineers believe that passengers could survive even a severe crash if they were equipped with the right safety devices. See how they test their ideas on page 26.



This wicked looking instrument was built as a class project. To find out what it is and why it was built, see the story beginning on page 32.

This is an unusual photograph of an all too familiar creature. For details on how the picture was taken, see the inside back cover.